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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1910

PART I—METALS

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MINERAL RESOURCES OF THE UNITED STATES IN 1910—PART I.

INTRODUCTION.

CHARACTER AND SCOPE OF THE REPORT.

The arrangement and scope of the statistical data contained in this report are practically the same as in the 26 preceding reports of the series, Mineral Resources of the United States. Each report records the development of the mineral industries of the United States since the time covered by the preceding number of the series; the reports should therefore be consulted together. Each chapter is a census of the productive features of the industry under discussion. The statistics of the imports and exports of minerals, which form an essential part of the volume, are obtained through the courtesy of the Chief of the Bureau of Statistics, Department of Commerce and Labor.

During recent years the majority of the chapters have been prepared by geologists of the Survey specialized in the subjects treated by them. The statistical treatment has been complemented by studies of the sources of the mineral production and the application of the products in the useful arts. The volumes have in this way grown into a cyclopedia of information, in fact as in name, on the Mineral Resources of the United States. As accurate knowledge as possible of nature's storehouses from which future supplies are to be drawn is recognized as of paramount importance, equal to, if not greater than, the record of past achievement.

COOPERATION WITH STATE GEOLOGICAL SURVEYS.

In the preparation of the present report, as in that for 1908, the United States Geological Survey has had the active cooperation of most of the State Geological Surveys. The statistics in such cases have been used jointly by the State and Federal Surveys, and the results have been checked before publication. The objects attained by cooperative agreement are three in number:

1. The avoidance of annoyance to the producers in the form of duplicate requests for statistical information.
2. The securing of prompter and more complete returns.
3. The enabling of the State geologists to keep in touch with the producers and with new developments in their respective jurisdictions.

Special acknowledgment is made of the assistance received by the United States Geological Survey from the directors of the State Surveys, and the cooperative arrangement has been carried out in a harmonious manner and with exceedingly gratifying results.

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The State Surveys which cooperated with the United States Geological Survey in 1910 are as follows:

Alabama.....Dr. Eugene A. Smith, State geologist, University.
Georgia.....Dr. S. W. McCallie, State geologist, Atlanta.
Illinois.....Mr. Frank W. De Wolf, director, Urbana.
Iowa.....Prof. S. W. Beyer, Iowa State College, Ames.
Kansas.....Dr. Erasmus Haworth, State geologist, Lawrence.
Kentucky.....Prof. C. J. Norwood, director, Lexington.
Maryland.....Dr. Wm. B. Clark, State geologist, Baltimore.
Michigan.....Mr. R. C. Allen, director, Lansing.
Missouri.....Dr. H. A. Buehler, State geologist, Rolla.
New Jersey.....Dr. Henry B. Kümmel, State geologist, Trenton.
North Carolina.....Dr. Jos. Hyde Pratt, State geologist, Chapel Hill.
Oregon.....Prof. H. M. Parks, director, Corvallis.
Pennsylvania.....Mr. Benj. L. Miller, Lehigh University, South Bethlehem.
Virginia.....Dr. Thos. L. Watson, director, Charlottesville.
Wisconsin.....Mr. W. O. Hotchkiss, State geologist, Madison.

ACKNOWLEDGMENTS.

Except as noted and in a few isolated instances where some other well-established agency already exists by which the statistics are collected accurately, the figures are obtained directly from the producers, and it is impossible to acknowledge here, otherwise than by brief mention, the invaluable assistance which has been freely rendered by them and by the voluntary contributions of many local experts. The technical press, besides affording much information concerning new mining enterprises, has been largely drawn upon for prices, market reports, and new technical processes.

As heretofore, the publication of this report has been anticipated to a great extent by the issue in advance, in pamphlet form, of nearly all the several chapters which compose it.

The summary gives the principal statistical information recorded in this report.

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SUMMARY OF THE MINERAL PRODUCTION OF THE UNITED STATES IN 1910.

COMPILED BY W. T. THOM.

GENERAL REMARKS.[1]

The different units of measurement employed in the mineral industry make it impossible to compare the outputs of the several minerals, except in the value of the products.

In 1905, for the first time, and in 1906, for the second time, the total value of the domestic mineral production exceeded the enormous sum of $1,500,000,000; and in 1907, for the first time, and again in 1910, the still greater sum of $2,000,000,000 was exceeded.

In 1908 the disastrous results of the financial depression of the latter part of 1907 became only too apparent in the decrease in value of the mineral output, which declined for the year to about $1,595,000,000 from over $2,000,000,000 in 1907. In 1909 the general recovery in business carried the value of the domestic mineral production up to $1,886,772,843. In 1910 the continued favorable business conditions raised the value again almost to the high level of 1907, the value in 1910 being $2,003,744,869, as compared with $1,886,772,843 in 1909, with $1,594,572,055 in 1908, with $2,071,613,741 in 1907, and with $1,904,011,381 in 1906—a gain in 1910 over 1909 of $116,972,026, or 6.20 per cent; a gain over 1908 of $409,172,814, or 25.65 per cent; a loss from 1907 of $67,868,872, or 3.28 per cent; and a gain over 1906 of $99,733,488, or 5.24 per cent.

As heretofore, iron and coal are the most important of our mineral products. The value of iron in 1910 was $425,115,235; the value of coal was $629,557,021. The fuels—coal, natural gas, and petroleum—increased from $746,203,792 in 1909 to $822,453,349 in 1910, a gain of $82,005,715, or 10.99 per cent. Anthracite coal showed an increase in value of $11,093,715, from $149,181,587 in 1909 to $160,275,302 in 1910. The increase in value of the bituminous-coal output from $405,486,777 in 1909 to $469,281,719 in 1910 was $63,794,942, or 15.73 per cent.

The gain in 1910 of $116,972,026 in the total value of our mineral production was due to gains in both metals and nonmetals, the metals showing an increase from $753,496,439 in 1909 to $760,743,467 in 1910, a gain of $7,247,028, and the nonmetals showing an increase from $1,132,976,404 in 1909 to $1,242,701,402 in 1910, a

[1] The imports cited in this summary and in the volume are "imports for consumption," which may or may not be identical with the "total imports" for the calendar year. Merchandise brought into the country late in December, for example, may be entered for consumption or it may be put into a warehouse and not be withdrawn for consumption until some months later. It will then be credited for consumption to the year of its withdrawal from the warehouse.

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gain of $109,724,998. To these products should be added estimated unspecified products, including bismuth, cadmium, selenium, vanadium, and other mineral products, valued at $300,000, which bring the total value of the mineral production for 1910 up to $2,003,744,869.

METALS AND ORES.

Metals and metallic ores.—According to the report, published for the first time in this series in the volume for 1909, the output of metals in the United States in 1909 from domestic ores was valued at $720,950,294, from foreign sources at $135,358,858, and from undistributed sources at $14,205,227, the total value being $870,514,379; the output in 1910 from domestic ores was valued at $720,531,399, from foreign sources at $144,945,434, and from undistributed sources at $16,144,621, the total value being $881,621,454. The output of crude metallic ores of all kinds from domestic mines amounted in 1909 to 111,900,807 short tons and in 1910 to 120,366,902 short tons.

Iron and steel.—Twenty-three States produced pig iron in 1910, as in 1909 and in 1908, against 21 in 1907 and 20 in 1906. The total production of pig iron in 1910 was 27,303,567 long tons, valued at $425,115,235, as compared with 25,795,471 long tons, valued at $419,175,000, in 1909 and with 21,320,797 long tons, valued at $381,090,800, the average annual output and value for the five years from 1904 to 1908, inclusive. The production in 1910 showed an increase in quantity of 1,508,096 long tons, or 5.85 per cent, over the production of 1909, and an increase in value of $419,175,000 to $425,115,235, amounting to $5,940,235, or 1.42 per cent. The average price per long ton of pig iron rose from $19.98 in 1906 to $20.56 in 1907, fell to $15.96 in 1908, rose to $16.25 in 1909, and fell to $15.57 in 1910. The imports of pig iron in 1910 (including pig iron, valued at $1,487,265; scrap, $925,954; ferrochrome, $79,429; ferromanganese, $4,341,071; ferrophosphorus, $5,171; ferrosilicon, $527,157; ferrotungsten, $678,534; spiegeleisen, $489,047) were valued at $8,533,628; in 1909 the imports (including pig iron, valued at $883,778; scrap, $773,529; ferrochrome, $43,504; ferromanganese, $3,396,381; ferrosilicon, $430,169; ferrotungsten, $93,205; spiegeleisen, $356,447; ferrophosphorus, $5,380) were valued at $5,979,395. The exports (including scrap) were valued at $1,399,151 in 1909 and at $2,489,446 in 1910.

Iron ore.—The production of iron ore in 1910 amounted to 56,889,734 long tons, valued at the mines at $140,735,607, as compared with 51,155,437 long tons, valued at $109,964,903, in 1909, and with 41,113,116 long tons, valued at $86,511,485, the average yearly production for the five years 1904 to 1908, inclusive. As in the 11 preceding years, the production of iron ore in the United States in 1910 was never equaled by that of any other country. The imports of iron ore in 1910 were valued at $7,832,225, against $4,579,078 in 1909 and against $2,458,542, the average annual value for the five years from 1904 to 1908. The exports in 1910 were valued at $2,074,164, as against $1,365,325 in 1909, $1,012,924 in 1908, and $763,422 in 1907.

Manganese ore.—The production of manganese ore was 2,258 long tons, valued at $22,892, in 1910, as against 1,544 long tons, valued at $19,675, in 1909 and against 5,187 long tons, valued at $55,992, the

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average annual production for the five preceding years. The average price per ton was $12.73 in 1906, $11.31 in 1907, $10.22 in 1908, $12.74 in 1909, and $10.14 in 1910. Manganiferous ore, carrying from 20 to 40 per cent of manganese, was produced to the extent of 61,101 long tons, valued at $186,765, in 1910, as against 68,654 long tons, valued at $215,925, in 1909. The imports of manganese ore in 1910 were 242,348 long tons, valued at $1,711,131, as against 212,765 long tons, valued at $1,405,329, in 1909.

Gold.—The production of gold was 4,657,018 fine ounces, valued at $96,269,100, in 1910, as compared with 4,821,701 ounces valued at $99,673,400, in 1909, and with 4,334,541 ounces, valued at $89,602,980, the average annual production for the preceding five-year period.

Silver.—The production of silver in 1910 was 57,137,900 fine ounces, valued at $30,854,500, as against 54,721,500 ounces, valued at $28,455,200, in 1909, and against 55,851,560 ounces, valued at $34,256,935, the average yearly production for the five years from 1904 to 1908, inclusive.

Copper.—The production of copper in 1910 was 1,080,159,509 pounds, valued at $137,180,257, as against 1,092,951,624 pounds, valued at $142,083,711, in 1909, and against 888,763,603 pounds, valued at $144,248,017, the average production for the five-year period ending with 1908. The imports in 1910 were valued at $40,849,239, as against $38,762,951 in 1909, $29,664,129 in 1908, and $46,912,347 in 1907. The exports in 1910 were valued at $96,554,432, as against $93,919,956 in 1909, $91,809,675 in 1908, and $103,252,917 in 1907.

Lead.—The production of lead in 1910 was 372,227 short tons, valued at $32,755,976, as compared with 354,188 tons, valued at $30,460,168, in 1909, and with 327,016 short tons, valued at $31,964,209, the average annual production for the five years next preceding. The imports of lead were valued at $755,092 in 1910, against $861,506 in 1909, $516,244 in 1908, and $1,082,944 in 1907. The exports were valued at $614,158 in 1910, against $509,542 in 1909, at $599,640 in 1908, and at $686,096 in 1907. The imports of type metal were valued at $485,493 in 1910, at $532,108 in 1909, and at $156,847 in 1908.

Antimonial lead.—The production of antimonial lead in 1910 was 14,069 short tons, valued at 1,338,090, as against 12,896 short tons, valued at $1,231,019 in 1909; 13,629 short tons, valued at $1,264,771, in 1908; and 9,910 short tons, valued at $1,322,985, in 1907.

Zinc.—The production of zinc in 1910 was 252,479 short tons, valued at $27,267,732, as compared with 230,225 short tons, valued at $24,864,300, in 1909, and with 200,948 short tons, valued at $22,283,873, the average annual production for the five-year period ending with 1908. The imports of zinc were valued at $1,027,941 in 1910, at $2,207,155 in 1909, at $753,461 in 1908, and at $1,846,445 in 1907; the exports were valued at $1,558,271 in 1910, at $1,222,173 in 1909, at $1,683,887, in 1908, and at $1,401,831 in 1907.

Bauxite.—In 1910 the production of bauxite was 148,932 long tons, valued at $716,258, as compared with 129,101 long tons, valued at $679,447, in 1909; with 52,167 long tons, valued at $263,968, in 1908; with 97,776 long tons, valued at $480,330, in 1907; with 75,332 long tons, valued at $368,311, in 1906; and with 64,213 long tons, valued at $317,721, the average annual production for the five-year period

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from 1904 to 1908. The imports for consumption in 1910 were 15,669 long tons, valued at $65,743, as against 18,688 long tons, valued at $83,956, in 1909; 21,679 long tons, valued at $87,823, in 1908; and 25,066 long tons, valued at $93,208, in 1907.

Aluminum.—The consumption of aluminum during 1910 was 47,734,000 pounds, valued at $8,955,700, as against 34,210,000 pounds, valued at $6,575,000, in 1909, and against 12,622,000 pounds valued at $3,469,823, the annual average consumption for the period from 1904 to 1908. The imports of aluminum salts in 1910 were valued at $53,671, against $29,061 in 1909. The exports of manufactures of aluminum were valued at $949,215 in 1910, against $567,375 in 1909, and $330,092 in 1908.

Quicksilver.—The production of quicksilver in 1910 amounted to 20,601 flasks, valued at 958,153, as against 21,075 flasks, valued at $957,859, in 1909, and against 26,516 flasks, valued at $1,043,725, the annual average for the five years from 1904 to 1908. California reported 17,211 flasks in 1910, as against 16,078 flasks in 1909. Texas reported 3,320 flasks, as against 4,188 flasks in 1909. Nevada reported 70 flasks in 1910, there being no production from Oregon, as against a combined production from the two States of 809 flasks in 1909. No output was reported from Arizona or Utah in 1910. The imports were valued at $381 in 1910; at $8,203 in 1909, and at $8,216 in 1908; the exports were valued at $91,077 in 1910, at $266,243 in 1909, and at $124,960 in 1908.

Chromic iron ore.—The production (California) of chromite in 1910 was 205 long tons, valued at $2,729, as compared with 598 long tons (California and Wyoming), valued at $8,300, in 1909; with 359 long tons (California), valued at $7,230, in 1908; with 290 long tons, valued at $5,640, in 1907; and with 107 long tons, valued at $1,800, in 1906. The imports in 1910 were 38,579 long tons, valued at $415,768, as against 39,624 long tons, valued at $460,758, in 1909.

Molybdenum minerals.—No production of molybdenum was reported in 1908, 1909, or 1910. There was a small commercial production in 1907 as in 1906 and 1905. Imports in 1910 were valued at $14,402.

Nickel.—The production of nickel in 1908, 1909, and 1910 is included under unspecified products. There was no production of metallic nickel reported in 1907 as in 1906 and 1905, only a small quantity of nickel and cobalt ore being reported as sold. The imports of nickel in 1910 were valued at $4,227,838, as against $3,036,273 in 1909, $2,497,585 in 1908, $2,243,026 in 1907, and $1,902,367 in 1906; the exports in 1910 were valued at $4,704,088, as against $4,101,976 in 1909 and $3,297,988 in 1908.

Titanium ore.—A production of rutile estimated at $44,480 was reported from Virginia in 1910, against $10,000 in 1909; none was reported in 1908. There was a small output from Virginia in 1907.

Tungsten ore.—The commercial production of concentrated tungsten ore in 1910 was 1,821 short tons, valued at $807,307, as against 1,619 short tons, valued at $614,370, in 1909, and against the average annual production for the five preceding years of 956 short tons, valued at $384,309. The imports of tungsten ore in 1910 were valued at $344,979, as against $105,506 in 1909.

Uranium and vanadium minerals.—An output of vanadium was reported in 1910 as in 1909, but no uranium. No output of either was reported for 1908. The production in 1907, as in 1906, was

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included under unspecified products. The production in 1905 was valued at $375. Imports of uranium salts and oxide were valued in 1910 at $10,176, against $12,057 in 1909, $7,145 in 1908, and $8,619 in 1907.

Tantalum minerals.—A very small output of tantalum ore was reported as mined in 1910, as in 1909; none seems to have been marketed in either year.

Platinum.—The production of refined platinum from domestic ores in 1910 was 773 ounces, valued at $25,277, as compared with 638 ounces, valued at $15,950, in 1909, and with 613 ounces, valued at $15,907, the average annual production for the five years ending with 1908. The average price per ounce in 1909 was $24.98, and in 1910 it was $32.70. The imports of platinum in 1910 were valued at $3,654,664, as against $2,973,948 in 1909, $1,229,873 in 1908, and $2,684,642 in 1907.

Iridium, osmium, palladium, and rhodium.—In 1909 imports of iridium, valued at $125,878, of osmium, valued at $1,569, and of palladium, valued at $13,416, were reported. In 1910 these imports were: Iridium, $140,232; osmium, $32,647; palladium, $3,570; and rhodium, $4,356. The production of these metals from domestic ores in the United States is negligible.

Antimony.—There was no production of antimony reported in 1908, 1909, or 1910. The production in 1907 was 351 short tons, valued at $77,300, as compared with 1,766 short tons, valued at $602,949, in 1906, and with 3,240 short tons, valued at $705,787, in 1905. The imports of antimony (metal, regulus, and ore) in 1910 were valued at $539,755, as against $714,366 in 1909, $878,136 in 1908, and $1,588,764 in 1907; imports of antimony salts in 1910 were valued at $14,201, as against $60,353 in 1909, $65,898 in 1908, and $98,038 in 1907.

Bismuth.—The only production of bismuth in 1909 was at Grasselli, Ind., and may not be disclosed. There was a small production of bismuth in 1908; no production was reported in 1907. The marketed production of bismuth ore in 1906 was 8,334 pounds, valued at $12,500, and in 1905 it was 24,405 pounds, valued at $4,187. The imports in 1910 were valued at $332,668, as against $286,516 in 1909, $257,397 in 1908, and $325,015 in 1907.

Tin.—In 1910 nominal outputs of tin as ore, concentrates, and metal were reported to the survey, valued at $23,447, and coming from Alaska, North Carolina, South Dakota, and Texas. A small production of metallic tin was reported from South Dakota in 1909, valued at $4,832. A few tons of stream tin were produced from Buck Creek, Alaska, and were shipped to Penzance, England—as to Hamburg, Germany, in 1908. The imports of tin in 1910 were valued at $33,913,255, as against $27,558,546 in 1908, $23,923,560 in 1908, and $32,074,263 in 1907.

Cadmium.—Cadmium was pronounced by the Grasselli Chemical Co., of Cleveland, Ohio, in 1906; there was a small production also in 1907, 1908, 1909, and 1910. The imports of cadmium were valued at $2,295 in 1910, as against $4,559 in 1909, $2,390 in 1908, $1,633 in 1907, and $10,522 in 1906.

Selenium and tellurium.—There was a small output of selenium in 1910, as in 1909. Selenium is recovered in the anode mud or slimes of the electrolytic copper refineries, particularly at Baltimore, Md.,

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and at Perth Amboy and Chrome, N. J. Tellurium is found combined in large quantities with gold and silver at Cripple Creek, Colo., in smaller quantities at other mining camps of the West, and also in the mud or slimes of electrolytic copper refineries.

FUELS.

Coal.—For the fifth time in the history of the United States the production of coal reached in 1910 a total of over 400,000,000 short tons. The output in 1910 was 501,596,378 short tons, valued at $629,557,021, as against 460,803,416 short tons, valued at $554,668,364, in 1909, and against 410,980,487 short tons, valued at $536,220,228, the average production for the five-year period from 1904 to 1908. Of this total, the output of anthracite coal in 1910 was 75,433,246 long tons, valued at $160,275,302, as compared with 72,384,249 long tons, valued at $149,181,587, in 1909. The value of anthracite coal at the mines in 1910 was $160,275,302, as against $149,181,587 in 1909, $158,178,849 in 1908, $163,584,056 in 1907, and $131,917,694 in 1906—an increase in 1910 as compared with 1909 of $11,093,715. The average price of the anthracite coal actually sold during the 1910 season at the mine was $2.13 per long ton, against $2.06 in 1909 and $2.13 in 1908.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals) amounted in 1910 to 417,111,142 short tons, valued at $469,281,719, as compared with 379,744,257 short tons, valued at $405,486,777, in 1909; 332,573,944 short tons, valued at $374,135,268, in 1908; with 394,759,112 short tons, valued at $451,214,842, in 1907; and with 342,874,867 short tons, valued at $381,162,115, in 1906. The increase in the production of bituminous coal in 1910 over 1909 was, therefore, 37,366,885 short tons, or 9.84 per cent, in quantity and $63,794,942, or 15.73 per cent, in value. The average price of bituminous coal per ton at the mines in 1910 was $1.12, as against $1.07 in 1909, $1.12 in 1908, $1.14 in 1907, $1.11 in 1906, $1.06 in 1905, $1.10 in 1904, and $1.24 in 1903—the highest price recorded by the Survey. The imports of anthracite in 1910 were valued at $42,244, against $12,918 in 1909 and $73,778 in 1908; the imports of bituminous were valued at $3,975,561, against $3,628,533 in 1909 and $3,964,843 in 1908. The exports were in 1910, anthracite, $14,785,387; bituminous, $26,685,405; in 1909, anthracite, $14,141,468; bituminous, $24,300,050; in 1908, anthracite, $13,524,595; bituminous, $23,361,914.

Coal briquets.—The production of coal briquets in the United States in 1909 was 139,661 short tons, valued at $452,697, as compared with 90,358 short tons, valued at $323,057, in 1908, and with 66,524 short tons, valued at $258,426, in 1907. The production was not reported in 1910.

Coke.—The production of coke in 1910 amounted to 41,708,810 short tons (7,138,734 tons from retort ovens), valued at $99,742,701, as against 39,315,065 short tons (6,254,644 tons from retort ovens), valued at $89,065,483, in 1909, and against 31,821,307 short tons, valued at $72,850,456, the average for the five years from 1904 to 1908. The average price per ton in 1910 was $2.39, against $2.29 in 1909, $2.40 in 1908, and $2.74 in 1907. The average output from the by-product ovens in 1910 was 1,762 short tons per oven, against

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1,598 short tons per oven in 1909, 1,142 tons per oven in 1908, and 1,472 tons per oven in 1907. The average output from beehive ovens in 1910 was 376 tons per oven, against 361 short tons per oven in 1909, 258 tons in 1908, and 386.8 tons in 1907. The imports of coke were valued at $625,130 in 1910, against $736,120 in 1909, $606,294 in 1908, and $596,366 in 1907. The exports were valued at $3,053,293 in 1910, against $3,232,673 in 1909, $2,161,032 in 1908, and $3,206,793 in 1907.

Natural gas.—The value of natural gas produced in 1910 was $70,756,158, as compared with $63,206,941 in 1909; and with $47,199,264, the average annual value for the preceding five-year period. No imports of natural gas in 1910 were reported, as against $6,060 in 1909, and $22,003 in 1908.

Petroleum.—The total production of crude petroleum in 1910 was 209,556,048 barrels, valued at $127,896,328, as against 183,170,874 barrels, valued at $128,328,487, in 1909, and against 144,583,033 barrels, valued at $105,392,704, the average annual production for the years 1904 to 1908. Among the noteworthy changes in the industry in 1910, California increased her output of 1909 by 31.6 per cent, which gain was the statistical feature of the year; Louisiana more than doubled her yield, owing to the Caddo field; and nine States showed the usual decline of old fields. The average price for crude petroleum per barrel in 1910 was 61 cents, against 70.1 cents in 1909, and against 73.3 cents, the average price for the years 1904 to 1908. The imports of petroleum in 1910 were valued at $136,292, as against $276,459 in 1909, $617,659 in 1908, and $286,252 in 1907. The exports in 1910 were valued at $94,107,022, as against $103,838,590 in 1909, $108,815,055 in 1908, and $91,283,064 in 1907.

The imports of ozokerite and paraffin in 1910 were valued at $1,025,701, as against $1,422,126 in 1909, $438,628 in 1908, and $186,182 in 1907. The exports of paraffin and paraffin wax were valued at $7,329,143 in 1910, as against $7,608,624 in 1909, and against an average annual value of $8,348,043 for the years from 1904 to 1908.

Peat.—The commercial production of peat in 1910 in the form of peat fertilizer filler, peat fuel, and peat moss litter was valued at $140,209, against $127,042 in 1909 and $133,000 in 1908. The imports of peat moss litter have averaged about $45,000 for the last five years.

STRUCTURAL MATERIALS.

Cement.—The total production of hydraulic cement in the United States in 1910 was 77,785,141 barrels, valued at $68,752,092, as compared with 66,689,715 barrels, valued at $53,610,563, in 1909, and with 45,583,855 barrels, valued at $43,529,447, the annual average production for the years 1904 to 1908. The Portland cement production in 1910 was 76,549,951 barrels, valued at $68,205,800, as compared with 64,991,431 barrels, valued at $52,858,354, in 1909. The production of natural cement in 1910 was 1,139,239 barrels, valued at $483,006, as compared with 1,537,638 barrels, valued at $652,756, in 1909. The production of puzzolan cement in 1910 amounted to 95,951 barrels, valued at $63,286, as against 160,646 barrels, valued

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at $99,453, in 1909. The imports of hydraulic cement in 1910 were valued at $395,526, as compared with $627,116, in 1909, with $1,206,832 in 1908, and with $2,614,228 in 1907. The exports were valued at $3,477,981 in 1910, against $1,417,534 in 1909, $1,249,229 in 1908, and $1,450,841 in 1907.

Clay products.—The value of all clay products in 1910 as reported to this office was $170,115,974, as against $166,321,213 in 1909, and against $146,778,658, the average annual value for the five preceding years. The pottery products were valued at $33,784,678 in 1910, as against $31,049,441 in 1909. The imports of pottery in 1910 amounted to $11,127,405, as against $10,607,212 in 1909, $10,522,791 in 1908, and $13,585,612 in 1907; the imports of brick in 1910 were valued at $206,613, against $189,536 in 1909 and $162,341 in 1908. The exports of brick in 1910 were valued at $1,602,913 and the exports of pottery at $1,041,689. The imports of kaolin or china clay in 1910 were valued at $1,593,472, as against $1,505,779 in 1909 and $1,129,847 in 1908. The imports of other clays amounted to $320,891 in 1910, as against $295,011 in 1909 and $189,454 in 1908.

Lime.—The production of lime in 1910 was 3,481,780 short tons, valued at $13,894,962, against 3,484,974 short tons, valued at $13,846,072 in 1909, and against 2,949,879 short tons, valued at $11,424,336, the average annual value for the years 1904 to 1908, The average price per short ton was $3.90 in 1906, $4.09 in 1907, $4.01 in 1908, $3.97⅓ in 1909, and $3.99 in 1910. The imports in 1910 were 6,498 short tons, valued at $63,791, as against 8,687 short tons. valued at $75,556, in 1909, and 5,060 tons, valued at $28,952, in1908. The exports reported in 1910 were 164,602 barrels, valued at $127,952,

Sand and gravel.—The production of sand for molding, building, engine, furnace, and other uses and of gravel reported in 1910 was 66,949,347 short tons, valued at $19,520,919, as against 58,461,100 short tons, valued at $17,173,615, in 1909, and against $10,386,875, the average annual value for the five years from 1904 to 1908. The imports of sand in 1910 were valued at $133,757, as compared with $106,234 in 1909 and with $77,574 in 1908.

Sand-lime brick.—The production of sand-lime brick in 1910 was valued at $1,169,153, as against $1,150,580 in 1909 and against $972,133, the average value for the five-year period from 1904 to 1908.

Slate.—The production of slate in 1910 was valued at $6,236,759, against $5,441,418 in 1909 and against $5,823,557, the average annual value for the period 1904 to 1908. The imports of slate in 1910 were valued at $4,127, against $7,872 in 1909 and $7,227 in 1908. The exports of roofing slate were not reported separately in 1910; in 1909 they were valued at $209,383 and at $197,216 in 1908.

Stone.—The value of all kinds of stone produced in the United States in 1910 amounted to $76,520,584; in 1909 it was $71,345,199; and the annual average value for the period 1904 to 1908 was $65,152,224. The imports of marble and stone were valued in 1910 at $1,569,143 and the exports at $1,538,339, as against $1,663,025 and $1,170,819, respectively, in 1909.

Included under stone is the limestone used for fluxing in blast furnaces, which in 1910 was 18,203,882 long tons, valued at $9,345,733, as against 15,772,863 long tons, valued at $7,921,807 in 1909 and against an average production of 14,066,574 long tons, valued at $6,873,891 for the years 1904 to 1908.

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ABRASIVE MATERIALS.

Artificial abrasives.—The total production of the artificial abrasives, alundum, carborundum, and crushed steel, in 1910 amounted to 23,027,000 pounds, valued at $1,604,030, as against 20,468,000 pounds, valued at $1,365,820, in 1909 and against an verage annual production for the five years 1904 to 1908 of 11,358,936 pounds, valued at $7,925,986.

Corundum and emery.—No domestic corundum was reported in 1909 or 1910. The output of emery was 1,028 short tons, valued at $15,077 in 1910 as against 1,580 short tons, valued at $18,185, in 1909, and against an average annual value of the combined production of corundum and emery for the five years ending in 1908 of $36,760. The imports were valued at $816,167 in 1910, at $338,997 in 1909, at $248,399 in 1908, and at $412,630 in 1907.

Garnet.—The production of abrasive garnet during 1910 amounted to 3,814 short tons, valued at $118,574 in 1910, as against 2,972 short tons, valued at $102,315 in 1909, and against 4,522 short tons, valued at $139,796, the annual average for the years 1904 to 1908. The average price per ton was $31.09 in 1910, against $34.43 in 1909, $32.37 per ton in 1908, and $30 per ton in 1907.

Grindstones.—The total value of all kinds of grindstones and pulp stones produced in 1910 was $796,294, as against $804,051 in 1909 and against $767,229, the average annual value for the period 1904 to 1908. The imports were valued at $106,596 in 1910, at $99,153 in 1909, at $80,382 in 1908, and at $111,495 in 1907.

Infusorial earth and tripoli.—The value of the infusorial earth and tripoli production in 1910 was $130,006, against $122,348 in 1909 and against $76,551, the average annual value for the years 1904 to 1908. The imports of rotten stone and tripoli were valued at $116,057 in 1910, at $24,024 in 1909, at $17,252 in 1908, and at $27,121 in 1907.

Millstones and burrstones.—The value of the production of millstones and burrstones in 1910 was $28,217, as against $35,393 in 1909 and as against $37,413, the annual average for the five preceding years. The imports were valued at $34,763 in 1910, at $22,590 in 1909, and a $18,642 in 1908.

Oilstones and whetstones.—The production of oilstones and whetstones in 1910 was valued at $228,694, as against $214,019 in 1909 and against the average annual value of $236,615 for the five years 1904 to 1908. The imports were valued at $45,819 in 1910, at $68,018 in 1909, at $44,304 in 1908, and at $89,939 in 1907.

Pumice.—The production of pumice amounted to 23,271 short tons, valued at $94,943, in 1910, against 15,103 short tons valued at $33,439, in 1909 and against an average annual value of $20,156 for the period 1904 to 1908. The imports were valued at $104,425 in 1910, at $100,997 in 1909, at $67,094 in 1908, and at $85,647 in 1907.

CHEMICAL MATERIALS.

Arsenious oxide.—The domestic production of arsenious oxide (white arsenic) in 1910 amounted to 2,994,000 pounds, valued at $52,305, as against 2,428,313 pounds, valued at $52,946, in 1909. The production of 1908 (which could not be divulged) was considerably less in both quantity and value than the production of 1907, which was 3,502,000 pounds, valued at $163,000, as compared with

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1,474,000 pounds, valued at $63,460, in 1906. The imports of white arsenic, metallic arsenic, and arsenic sulphide in 1910 were valued at $314,306, as against $303,728 in 1909 $430,400 in 1908, and $574,998 in 1907.

Borax.—The reported returns for 1910 gave an aggregate production of crude borax of 42,357 short tons, valued at $1,201,842, as against 41,434 short tons, valued at $1,534,365, in 1909, and with $999,375, the average annual value from 1904 to 1908. The imports of borax in 1910 were valued at $12,397, as against $11,687 in 1909 and $36,764 in 1908.

Bromine.—The production of bromine in 1910 amounted to 245,437 pounds, valued at $41,684, as compared with 569,725 pounds, valued at $57,600, in 1909 and with 760,023 pounds, valued at $73,783, in 1908.

Fluorspar and cryolite.—The commercial production of fluorspar in 1910 was 69,427 short tons, valued at $430,196, as compared with 50,742 short tons, valued at $291,747, in 1909 and with 44,583 short tons, valued at $270,910, the average production for the years 1904 to 1908. It is estimated that the imports in 1908 amounted to about 22,000 short tons; 6,971 short tons, valued at $26,377, were reported as imported for consumption in 1909, and in 1910 42,488 short tons were imported, valued at $135,152. The imports of cryolite in 1910 were reported as valued at $2,343, as against $18,427 in 1909, $16,445 in 1908, and $28,902 in 1907.

Gypsum.—The output of crude gypsum in 1910 was 2,379,057 short tons, valued in its first marketable condition at $6,523,029, as compared with 2,252,785 short tons, valued at $5,906,738, in 1909 and with an annual average value of $3,733,924 for the five years from 1904 to 1908.

The greatly increased production of late years is attributable to the largely increased use of wall plaster and of plaster of Paris in large modern buildings. The imports in 1910 were valued at $502,111, as against $425,137 in 1909 and $354,403 in 1908.

Lithium minerals.—The production of lithium minerals in 1910 was small, as in 1909, and the figures may not be published.

Phosphate rock.—The total commercial production of phosphate rock reported to the Survey in 1910 amounted to 2,654,988 long tons, valued at $10,917,000, as compared with 2,330,152 long tons, valued at $10,772,120, in 1909, and with $8,795,280, the average annual value for the years 1904 to 1908. The total quantity of phosphate rock reported as mined during 1910 was 2,626,794 long tons, as against 2,444,437 long tons mined in 1909. The imports for consumption of crude phosphate in 1910 were 21,706 long tons, valued at $235,040, as against 9,983 long tons, valued at $99,060, in 1909; 14,311 long tons, valued at $82,863, in 1908; and 25,745 long tons, valued at $164,343, in 1907. The exports were 1,083,037 long tons, valued at $8,234,276, in 1910, as against 1,020,556 long tons, valued at $7,644,368, in 1909; 1,188,411 long tons, valued at $9,294,009, in 1908; and 1,018,212 long tons, valued at $8,387,176, in 1907.

Salt.—The salt product includes salt in the form of brine used in large quantities for the manufacture of soda ash, sodium bicarbonate, caustic soda, and other sodium salts. The domestic production of salt in 1910 amounted to 30,305,656 barrels of 280 pounds, valued at $7,900,344, as compared with 30,107,646 barrels, valued at $8,343,831,

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in 1909, and with $6,787,490, the value of the average annual output, 1904 to 1908. The imports in 1910 were valued at $370,922, as against $437,827 in 1909 and $444,690 in 1908. The exports in 1910 were valued at $320,926, as against $269,273 in 1909 and $202,338 in 1908.

Sulphur and pyrite.—The domestic production of sulphur in 1910 was 255,534 long tons, valued at $4,605,112, as against 239,312 long tons, valued at $4,432,066, in 1909, and against 253,134 long tons, valued at $4,655,613, the average annual production for the years 1904 to 1908. The production of pyrite in 1910 was 238,154 long tons, valued at $958,608, as against 247,070 long tons, valued at $1,028,157, in 1909, and against 238,298 long tons, valued at $867,333, the average annual production for the five years 1904 to 1908. The imports of sulphur fell in value from $2,511,269 in 1904 to $362,379 in 1908, rose to $549,632 in 1909, and to $558,611 in 1910. The exports in 1910 amounted to 30,742 long tons, valued at $552,941, as against 37,142 long tons, valued at $736,928, in 1909. The imports of pyrite were valued at $2,748,647 in 1910, at $2,428,580 in 1909, and at $2,624,339 in 1908.

PIGMENTS.

Barytes.—The production of crude barytes in 1910 was 42,975 short tons, valued at $121,746, as compared with 61,945 short tons, valued at $209,737, in 1909, and with 58,468 short tons, valued at $179,269, the average annual production for the five years from 1904 to 1908. The imports of barytes fell from $173,425 in 1907 to $87,990 in 1908, and to $54,707 in 1909, and rose to $78,239 in 1910. The imports of barium compounds fell from $357,117 in 1907 to $319,114 in 1908, and rose to $399,376 in 1909, and to $470,449 in 1910.

Cobalt oxide.—The production of cobalt oxide in 1908 and 1909 is included under unspecified products. No production was reported for 1910. A production was reported from Oregon and Missouri in 1907. No production was reported in 1905 and 1906. The imports in 1910 were valued at $6,352, as against $11,696 in 1909, and $17,077 in 1908.

Mineral paints.—The commercial production of mineral paints in 1910 amounted to 85,685 short tons, valued at $2,174,735, as compared with 78,771 short tons, valued at $2,373,805, in 1909; with 69,244 short tons, valued at $2,367,723, in 1908; and with 75,566 short tons, valued at $2,984,935, in 1907.

Zinc oxide.—The production of zinc oxide in 1910 amounted to 59,333 short tons, valued at $5,325,636, as compared with 68,974 short tons, valued at $6,156,755, in 1909, and with 66,944 short tons, valued at $5,578,243, the average production for the years 1904 to 1908. The imports of zinc oxide in 1910 were valued at $396,573, as against $397,084 in 1909 and $279,674 in 1908. The exports were valued at $943,968 in 1910, as against $1,026,377 in 1909 and $845,070 in 1908.

MISCELLANEOUS.

Asbestos.—The asbestos commercially produced in the United States in 1910 was obtained from deposits in Georgia and Vermont, with small quantities from Idaho and Wyoming. The total commercial production in 1910 was 3,693 short tons, valued at $68,357, as against

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3,085 short tons, valued at $62,603, in 1909, and against 1,575 short tons, valued at $25,761, the annual average production for 1904 to 1908. The imports for consumption were valued at $1,543,249 in 1910, as against $1,233,659 in 1909.

Asphalt.—Under this title are included the various bitumens or hydrocarbons not discussed elsewhere under the heading "Petroleum." The commercial production in 1910 was 260,080 short tons, valued at $3,080,067, as against 228,655 short tons, valued at $2,138,273, in 1909, and against 156,828 short tons, valued at $1,562,540, the average production for the five preceding years. The imports of asphalt in 1910 were valued at $785,963, as against $633,205 in 1909, $624,979 in 1908, and $648,564 in 1907. The exports for the fiscal year 1910 were valued at $702,520, as against $425,420 and $451,968 for the fiscal years 1909 and 1908, respectively.

Feldspar.—The production of feldspar in 1910 was 81,102 short tons, valued at $502 452, as against 76,539 short tons, valued at $424,602, in 1909; 70,474 short tons, valued at $428,553, in 1908; and 91,799 short tons, valued at $558,944, in 1907.

Fertilizers.—Fertilizers, including apatite, bone dust, guano, kainite, kieserite, and other manures, valued at $9,019,567, were imported in 1910, as against $5,871,733 in 1909, $1,893,732 in 1908, and $5,342,138 in 1907.

Fibrous talc.—This variety of talc or soapstone occurs in but one locality in the United States—Gouverneur, St. Lawrence County, N. Y. It is used principally as makeweight in the manufacture of paper. In 1910 the production was 71,710 short tons, valued at $728,180, as against 48,536 short tons, valued at $359,957, in 1909, and against 64,143 short tons, valued at $566,598, the average annual production for the years 1904–1908.

Fuller's earth.—As reported to the Survey, the production of fuller's earth in 1910 was 32,822 short tons, valued at $293,709, as against 33,486 short tons, valued at $301,604, in 1909, and against an average annual production for the years 1904 to 1908 of 29,856 short tons, valued at $243,707. The imports were valued at $132,545 in 1910, at $101,151 in 1909, at $93,413 in 1908, and at $122,221 in 1907.

Gems and precious stones.—The value of the gems and precious stones found in the United States in 1910 was reported at $295,797, as against $534,380 in 1909, $415,063 in 1908, $471,300 in 1907, and $208,000 in 1906. Pearls produced in 1907 were valued at $264,500, as against $381,000 in 1906. No production of pearls was reported for 1908, 1909, or 1910. Imports of precious stones in 1910 were valued at $40,704,487, as against $40,237,509 in 1909 and against an annual average value of $30,648,792 for the years 1904 to 1908.

Glass sand.—The production of glass sand in 1910 was 1,461,089 short tons, valued at $1,516,711, as against 1,104,451 short tons, valued at $1,163,375, in 1909, and $1,099,531, the average annual value for the period from 1904 to 1908.

Graphite.—The commercial production of crystalline graphite during 1910 amounted to 5,590,592 pounds, valued at $295,733, as compared with 6,294,400 pounds, valued at $313,271, in 1909, and with $203,614, the average annual value for the period from 1904 to 1908. The production of amorphous graphite in 1910 was 35,945 short tons, valued at $81,443, as compared with 5,096 short tons, valued at $32,238, in 1909, and with $93,362, the average value for the period

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from 1904 to 1908. The production of artificial graphite in 1910 was 13,149,100 pounds, valued at $945,000, the average price being 7.2 cents per pound, as compared with 6,664,017 pounds, valued at $480,000, the average price being 7.2 cents per pound, in 1909. The average annual value for the preceding five years was $370,576. The imports of graphite in 1910 were valued at $1,872,592, as against $1,854,459 in 1909, $762,367 in 1908, and $1,777,389 in 1907.

Magnesite.—The production of crude magnesite continues to be limited to California. During 1910 the commercial production was 12,443 short tons, valued at $74,658, as against 9,465 short tons, valued at $37,860 in 1909, and against 5,747 short tons, valued at $16,076, the average for 1904 to 1908. The imports of magnesite and magnesia in 1910 were valued at $1,578,683, as against $1,041,418 in 1909 and $775,642 in 1908.

Mica.—The total production of mica in 1910 was 2,476,190 pounds of sheet mica, valued at $283,832, and 4,065 short tons of scrap mica, valued at $53,265, as against 1,809,582 pounds of sheet mica, valued at $234,482, and 4,090 short tons of scrap mica, valued at $46,047, in 1909, and against annual values for the years 1904 to 1908 of $221,155 for sheet mica and of $25,631 for scrap mica. The imports of mica in 1910 were valued at $724,525, as against $618,813 in 1909 and $266,058 in 1908.

Mineral waters.—The total production of mineral waters in 1910 was 62,030,125 gallons, valued at $6,357,590, as compared with 64,674,486 gallons, valued at $6,894,134, in 1909, and with the average production of 48,910,285 gallons, valued at $6,956,539, for the years 1904 to 1908. The imports of mineral waters in 1910 were valued at $983,136, as against $1,085,177 in 1909 and $1,033,047 in 1908.

Monazite and zircon.—The production of monazite is confined to North Carolina and South Carolina exclusively, more than half being obtained from the first-named State. In 1910 the production was 99,301 pounds of concentrates, valued at $12,006, as against 543,931 pounds of concentrates, valued at $65,032, in 1909; 422,646 pounds of concentrates, valued at $50,718, in 1908; 548,152 pounds of concentrates, valued at $65,800, in 1907; and 847,275 pounds of concentrates (including about 1,100 pounds of zircon), valued at $152,560, in 1906. The imports of thorium nitrate in 1910 were 124,808 pounds, valued at $219,615, as against 127,833 pounds, valued at $236,057, in 1909; against 65,289 pounds, valued at $173,239, in 1908; and 51,441 pounds, valued at $152,666, in 1907. The imports of monazite and thorium oxide in 1910 were valued at $16,824, as against $27,920, in 1909. No imports were reported in 1908 or 1907.

The production of zircon in 1909 was 2,000 pounds, valued at $250. No production was reported in 1910.

Potassium salts.—No production of potassium salts in the United States was reported in 1910, 1909, 1908, or 1907. The imports in 1910 were valued at $7,986,480, as against $7,877,955, in 1909, and against an average annual value of $5,430,365 for the years 1904 to 1908.

Quartz.—The production of quartz in 1910 was 63,577 short tons, valued at $193,757, as compared with 135,469 short tons, valued at $249,466, in 1909; with 47,316 short tons, valued at $190,157, in 1908; and with 33,192 short tons, valued at $223,801, in 1907. The

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value of the unground flint stones imported in 1910 was $307,286, as against $301,547, in 1909, $219,754 in 1908, and $288,371 in 1907.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1910 amounted to 79,006 short tons, valued at $864,213, as compared with 81,802 short tons, valued at $862,002, in 1909, and with 48,983 short tons, valued at $710,726, the average annual production for the five-year period from 1904 to 1908. The imports of talc in 1910 were valued at $106,460, as against $56,287 in 1909, and $97,096 in 1908.

MINERAL PRODUCTION OF THE UNITED STATES IN 1909 AND 1910.

From the tabular statement headed "Mineral products of the United States in 1909 and 1910," including also the tables for the years 1880 to 1910, all unnecessary duplication has been excluded. The manufactured coke product, amounting in 1910 to 41,708,810 short tons, and valued at $99,742,701, is excluded, as the quantity and value of the coal used in its manufacture are included in the statistics of coal production. Similarly, white lead, red lead, lithopone, Venetian red, litharge, and orange mineral, whose average aggregate value for the last 10 years has largely exceeded $15,000,000, are not given in the table, the base from which they are made being included in the output of pig lead. Zinc white or zinc oxide, zinc-lead, sublimed blue lead, and sublimed white lead, on the other hand, made directly from the ores, and consequently not included in zinc or lead production, are tabulated. The production of pig iron and its value are given in the table as the best means of presenting the statistics of the production of iron in the first marketable condition, the value of iron ores being excluded. Similarly, the value of the products of the clay industries is given as being the first marketable condition of the greater part of the clay produced, although the production and value of the clay mined and sold in the raw state by clay miners to manufacturers of clay are elsewhere shown separately, but are not included in the tabular statement, in order to avoid duplication.

The figures for gold and silver for 1909 and 1910 are the official figures agreed upon by the United States Geological Survey and the Director of the Mint. The figures for the tonnage (not the value) of pig iron in 1909 and 1910 are from the reports of Mr. James M. Swank, general manager of the American Iron & Steel Association.

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	Product.	1909.		1910.		Increase (+) or decrease − in 1910.		Percentage of increase (+) or decrease (−) in 1910.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	METALS.								
1	Pig iron,[a] spot value[b] ..... long tons[c]	25,795,471	$419,175,000	27,303,567	$425,115,235	+ 1,508,096	+$5,940,235	+ 5.85	+ 1.42
2	Silver, commercial value[d] .... troy ounces	54,721,500	28,455,200	57,137,900	30,854,500	+ 2,416,400	+ 2,399,300	+ 4.42	+ 8.43
3	Gold, coining value[e] ..... do	4,821,701	99,673,400	4,657,018	96,269,100	− 164,683	− 3,404,300	− 3.42	− 3.42
4	Copper,[f] value at New York City ..... pounds	1,092,951,624	142,083,711	1,080,159,509	137,180,257	−12,792,115	− 4,903,454	− 1.17	− 3.45
5	Lead,[f] value at New York City ..... do	354,188	30,460,168	372,227	32,755,976	+ 18,039	+ 2,295,808	+ 5.09	+ 7.54
6	Zinc,[f] value at St. Louis ..... short tons	230,225	24,864,300	252,479	27,267,732	+ 22,254	+ 2,403,432	+ 9.67	+ 9.67
7	Quicksilver, value at San Francisco, flasks[g]	21,075	957,859	20,601	958,153	− 474	+ 294	− 2.25	+ .03
8	Aluminum ..... pounds	[h] 34,210,000	6,575,000	[h] 47,734,000	8,955,700	+13,524,000	+ 2,380,700	+39.53	+ 36.21
9	Antimony[i]								
10	Antimonial lead ..... short tons	12,896	1,231,019	14,069	1,338,090	+ 1,173	+ 107,071	+ 9.09	8.70
11	Nickel,[j] value at Philadelphia .... pounds	.....	([k])	.....	.....	.....	.....	.....	.....
12	Tin ..... do	.....	[l] 4,832	.....	23,447	.....	+ 18,615	.....	+385.24
13	Platinum, value at New York City, troy ounces	638	15,950	773	25,277	+ 135	+ 9,327	+21.16	+ 58.48
14	Total value of metals	.....	753,496,439	.....	760,743,467	.....	+ 7,247,028	.....	+ .96

[a] Production of iron ore—1901: 28,887,479 long tons; value at mines, $49,256,245. 1902: 35,554,135 long tons; value at mines, $65,412,950. 1903: 35,019,308 long tons; value at mines, $66,328,415. 1904. 27,644,330 long tons; value at mines, $43,186,741. 1905: 42,526,133 long tons; value at mines, $75,165,604. 1906: 47,749,728 long tons; value at mines, $100,597,106. 1907: 51,720,619 long tons; value at mines, $131,996,147. 1908: 35,924,771 long tons; value at mines, $81,611,825. 1909: 51,155,437 long tons; value at mines, $109,964,903. 1910: 56,889,734 long tons; value at mines, $140,735,607. Statistics for iron ore and value of pig iron are collected by the Survey; statistics for pig iron output are furnished by the American Iron and Steel Association.

[b] By "spot" value is meant value at the point of production.

[c] Long tons are tons of 2,240 avoirdupois pounds; short tons are tons of 2,000 avoirdupois pounds.

[d] Average price per troy ounce in 1906 was 67 cents; in 1907 it was 66 cents; in 1908, 53 cents; in 1909, 52 cents.

[e] Prior to 1905, coining value, $20.6718 per troy ounce; in 1905, coining value, $20.671834; since 1905, coining value, $20.671834625323.

[f] The product from domestic ores only.

[g] Of 76½ avoirdupois pounds net; of 75 avoirdupois pounds net since June, 1904.

[h] Consumption in 1904, 1905, 1906, 1907, 1908, and 1909.

[i] Includes antimony smelted from imported ores, and also antimony contained in hard lead, except in 1907, 1908, 1909, and 1910.

[j] Includes nickel in copper-nickel alloy and in exported ore and matte.

[k] Includes nitrate of soda, carbonate of soda, sulphate of soda, and alum clays used by paper manufacturers; and bismuth, cadmium, lithium, selenium, and vanadium, valued together in 1910 at $277,000.

[l] In 1905 no production. In 1906, 2,500 pounds of metallic tin, 55 short tons of concentrates from Alaska, and 14 short tons of concentrates from North Carolina and South Carolina. In 1907 about 89 short tons of concentrates. In 1908 no production. In 1909 about 17 short tons of stream tin from Alaska were shipped to England. In 1910, 42,000 pounds of metallic tin from South Dakota and Texas; 16 short tons of ore and concentrates from Alaska and North Carolina.

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Mineral products of the United States in 1909 and 1910—Continued.

	Product.	1909.		1910.		Increase (+) or decrease (−) in 1910.		Percentage of increase (+) or decrease (−) in 1910.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	NONMETALS (SPOT VALUE [a]).								
15	Bituminous coal [b] ..... short tons..	379,744,257	$405,486,777	417,111,142	$469,281,719	+37,366,885	+$63,794,942	+ 9.84	+ 1.06
16	Pennsylvania anthracite ..... long tons..	72,384,249	149,181,587	75,433,246	160,275,302	+ 3,048,997	+ 11,093,715	+ 4.21	+ 7.44
17	Natural gas	.....	63,206,941	.....	70,756,158	.....	+ 1,793,059	.....	+ 2.84
18	Petroleum ..... barrels [c]..	183,170,874	128,328,487	200,556,048	127,896,328	+26,385,174	− 432,159	+ 14.40	− .34
19	Peat	.....	127,042	.....	140,209	.....	+ 13,167	.....	+ 10.36
20	Clay products [d]	.....	166,321,213	.....	170,115,974	.....	+ 3,794,761	.....	+ 2.28
21	Cement ..... barrels [e]..	66,689,715	53,610,563	77,785,141	68,752,092	+11,095,426	+ 15,141,529	+ 16.64	+ 28.24
22	Lime ..... short tons..	3,484,974	13,846,072	3,481,780	13,894,962	− 3,194	+ 48,890	− .09	+ .35
23	Sand, molding, building, etc., and gravel ..... do....	58,461,100	17,173,615	66,949,347	19,520,919	+ 8,488,247	+ 2,347,304	+ 14.52	+ 13.67
24	Sand-lime brick	.....	1,150,580	.....	1,169,153	.....	+ 18,573	.....	+ 1.61
25	Slate	.....	5,441,418	.....	6,236,759	.....	+ 795,341	.....	+ 14.62
26	Stone [f]	.....	71,345,199	.....	76,520,584	.....	+ 5,175,385	.....	+ 7.25
27	Corundum and emery ..... short tons..	1,580	18,185	1,028	15,077	− 552	− 3,108	− 34.94	− 17.09
28	Abrasive quartz and feldspar ..... do....	(g)	.....	.....	(h)	.....	.....	.....	.....
29	Garnet for abrasive purposes ..... do....	2,972	102,315	3,814	113,574	+ 842	+ 11,259	+ 28.33	+ 11.00
30	Grindstones	.....	804,051	.....	796,294	.....	− 7,757	.....	− .96
31	Infusorial earth and tripoli .... short tons..	.....	122,348	.....	130,006	.....	+ 7,658	.....	+ 6.26
32	Millstones	.....	35,393	.....	28,217	.....	− 7,176	.....	− 20.28
33	Oilstones, etc	.....	214,019	.....	228,694	.....	+ 14,675	.....	+ 6.86
34	Pumice ..... short tons..	15,103	33,439	23,271	94,943	+ 8,168	+ 61,504	+ 54.08	+183.93
35	Arsenious oxide ..... pounds..	2,428,000	52,946	2,994,000	52,305	+ 566,000	− 641	+ 23.31	− 1.21
36	Borax (crude) ..... short tons..	41,434	1,534,365	42,357	1,201,842	+ 923	− 332,523	+ 2.23	− 21.67
37	Bromine ..... pounds..	569,725	57,600	245,437	41,684	− 324,288	− 15,916	− 56.92	− 27.63
38	Fluorspar ..... short tons..	50,742	201,747	69,427	430,196	+ 18,685	+ 138,449	+ 36.82	+ 47.46
39	Gypsum ..... do....	2,252,785	5,906,738	2,379,057	6,523,029	+ 126,262	+ 616,291	+ 5.60	+ 10.43
40	Lithium minerals ..... do....	.....	(i)	.....	(i)	.....	.....	.....	.....
41	Phosphate rock ..... long tons..	2,330,152	10,772,120	2,654,988	10,917,000	+ 324,836	+ 144,880	+ 13.94	+ 1.34
42	Pyrite ..... do....	247,070	1,028,157	238,154	958,608	− 8,916	− 69,549	− 3.61	− 6.76
43	Sulphur ..... do....	239,312	4,432,066	255,534	4,605,112	+ 16,222	+ 173,046	+ 6.78	+ 3.90
44	Salt ..... barrels [k]..	30,107,646	8,343,831	30,305,656	7,900,344	+ 198,010	− 443,487	+ 6.04	− 5.32
45	Barytes (crude) ..... short tons..	61,945	209,737	42,975	121,746	− 18,970	− 87,991	− 30.62	− 41.95
46	Cobalt oxide ..... pounds..	.....	(i)	.....	.....	.....	.....	.....	.....
47	Mineral paints [l] ..... short tons..	78,771	2,373,805	85,685	2,174,735	+ 6,914	− 199,070	+ 8.78	− 8.39
48	Zinc oxide ..... do....	68,974	6,156,755	59,333	5,325,636	− 9,641	− 831,119	− 13.98	− 13.50
49	Asbestos ..... do....	3,085	62,603	3,693	68,357	+ 608	+ 5,754	+ 19.71	+ 9.19
50	Asphalt ..... short tons..	228,655	2,138,273	260,080	3,080,067	+ 31,425	+ $941,794	+ 13.74	+ 44.04
51	Bauxite ..... long tons..	129,101	679,447	148,932	716,258	+ 19,831	+ 36,811	+ 15.36	+ 5.42
52	Chromic iron ore ..... do....	598	8,300	205	2,729	− 393	− 5,571	− 65.72	− 67.12

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53	Feldspar.....short tons..	76,539	424,602	81,102	502,452	+ 4,563	+ 77,850	+ 5.96	+ 18.33
54	Fuller's earth.....do....	33,486	301,604	32,822	293,709	− 664	− 7,895	− 1.98	− 2.62
55	Gems and precious stones.....	.....	534,380	.....	295,797	.....	− 238,583	.....	− 44.65
56	Glass sand.....short tons..	1,104,451	1,163,375	1,461,089	1,516,711	+ 356,638	+ 353,336	+ 32.29	+ 30.37
57	Graphite, crystalline.....pounds..	6,294,400	313,271	5,590,592	295,733	− 703,808	− 17,538	− 11.18	− 5.60
	Graphite, amorphous.....short tons..	5,096	32,238	35,945	81,443	+ 30,849	+ 49,205	+605.36	+152.63
58	Magnesite.....do....	9,465	37,860	12,443	74,658	+ 2,978	+ 36,798	+ 31.46	+ 97.19
59	Manganese ore .....long tons..	1,544	19,675	2,258	22,892	+ 714	+ 3,217	+ 46.24	+ 16.35
60	Manganiferous ore .....do....	68,654	215,925	61,101	186,765	− 7,553	− 29,160	− 11.00	− 13.50
61	Mica, sheet.....pounds..	1,809,582	234,482	2,476,190	283,832	+ 666,608	+ 49,350	+ 36.84	+ 21.05
	Mica, scrap.....short tons..	4,090	46,047	4,065	53,265	− 25	+ 7,218	− .61	+ 15.68
62	Mineral waters.....gallons sold..	64,674,486	6,894,134	62,030,125	6,357,590	− 2,644,361	− 536,544	− 4.09	− 7.78
63	Quartz.....short tons..	135,469	249,466	63,577	193,757	− 71,892	− 55,709	− 53.07	− 22.33
64	Talc and soapstone.....do....	81,802	862,002	79,006	864,213	− 2,796	+ 2,211	− 3.42	+ .26
65	Talc, fibrous.....do....	48,536	359,957	71,710	728,180	+ 23,174	+ 368,223	+ 47.75	+102.30
66	Thorium minerals (monazite) and zircon .....pounds..	543,931	65,282	99,301	12,006	− 444,630	− 53,276	− 81.74	− 81.61
67	Titanium ore (rutile) .....do....	.....	10,000	566	44,480	+ 566	+ 34,480	.....	+344.80
68	Tungsten ore .....short tons..	1,619	614,370	1,821	807,307	+ 202	+ 192,937	+ 12.48	+ 31.40
69	Uranium and vanadium minerals...do....	.....	(e)	.....	(e)	.....	.....	.....	.....
70	Total value of nonmetals.....	.....	1,132,976,404	.....	1,242,701,402	.....	+103,968,840	.....	+ 9.18
71	Total value of metals.....	.....	753,496,439	.....	760,743,467	.....	+ 7,247,028	.....	+ .96
72	Estimated value of mineral products unspecified (f)	.....	300,000	.....	300,000	.....	.....	.....	.....
73	Grand total.....	.....	1,886,772,843	.....	2,003,744,869	.....	+111,215,868	.....	+ 5.89

a By "Spot" value is meant value at the point of production.

b Including brown coal and lignite and anthracite mined elsewhere than in Pennsylvania. Coke—1905: 32,231,129 short tons; value at ovens, $72,476,196. 1906: 36,401,217 short tons; value at ovens, $91,608,034. 1907: 40,779,564 short tons; value at ovens, $111,539,126. 1908: 26,033,518 short tons; value at ovens, $62,483,983. 1909: 39,315,065 short tons; value at ovens, $89,965,483. 1910: 41,708,810 short tons; value at ovens, $99,742,701.

c Of 42 gallons.

d Value of clay mined and sold as manufactured clay—1905: $2,768,006. 1906: $3,245,256. 1907: $3,448,548. 1908: $2,599,986. 1909: $3,449,707. 1910: $3,625,485.

e Of 380 pounds net.

f Of 764 avoirdupois pounds net; of 75 avoirdupois pounds net since June, 1904.

g Included under feldspar and quartz.

h Includes limestone for iron flux, but not grindstones.

i Includes nitrate of soda, carbonate of soda, sulphate of soda, and alum clays used by paper manufacturers; and bismuth, cadmium, lithium, selenium, and vanadium, valued together in 1910 at $277,000.

k Of 280 pounds net. Value is for net product exclusive of cost of packages.

l Includes since 1904 metallic paint, mortar colors, ocher, umber, sienna, shale, ground slate; since 1907 sublimed blue lead, sublimed white lead, zinc-lead, and leaded zinc oxide.

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Mineral products of the United States

	Product.	1880. Quantity.	1880. Value.
	METALS.		
1	Pig iron, value at Philadelphia.....long tons..	3,375,912	$89,315,569
2	Silver, commercial value.....troy ounces..	30,318,700	34,717,000
3	Gold, coining value.....do....	1,741,500	36,000,000
4	Copper, value at New York City.....pounds..	60,480,000	11,491,200
5	Lead, value at New York City.....short tons..	97,825	9,782,500
6	Zinc, value at New York City.....do....	23,239	2,277,432
7	Quicksilver, value at San Francisco.....flasks..	59,926	1,797,780
8	Nickel, value at Philadelphia.....pounds..	233,893	257,282
9	Aluminum, value at Pittsburg.....do....	.....	.....
10	Antimony, value at San Francisco.....short tons..	50	10,000
11	Platinum (crude), value at San Francisco.....troy ounces..	100	400
12	Total value of metallic products.....	.....	185,649,163
	NONMETALS (SPOT VALUE).		
13	Bituminous coal.....short tons..	38,242,641	53,443,718
14	Pennsylvania anthracite.....long tons..	25,580,189	42,196,678
15	Stone.....	.....	18,356,055
16	Petroleum.....barrels..	26,286,123	24,183,233
17	Lime.....do....	28,000,000	19,000,000
18	Natural gas.....	.....	.....
19	Cement.....barrels..	2,072,943	1,852,707
20	Salt.....do....	5,961,060	4,829,566
21	Phosphate rock.....long tons..	211,377	1,123,823
22	Limestone for iron flux.....do....	4,500,000	3,800,000
23	Mineral waters.....gallons sold..	2,000,000	500,000
24	Zinc white.....short tons..	10,107	763,738
25	Potters' clay.....do....	28,877	200,457
26	Mineral paints.....do....	3,604	135,840
27	Borax.....pounds..	3,692,443	277,233
28	Gypsum.....short tons..	90,000	400,000
29	Grindstones.....	.....	500,000
30	Fibrous talc.....short tons..	4,210	54,730
31	Pyrite.....long tons..	2,000	5,000
32	Soapstone.....short tons..	8,441	66,665
33	Manganese ore.....long tons..	5,761	86,415
34	Asphalt.....short tons..	444	4,440
35	Precious stones.....	.....	100,000
36	Bromine.....pounds..	404,690	114,752
37	Corundum.....short tons..	1,044	29,280
38	Barytes (crude).....do....	20,000	80,000
39	Graphite.....pounds..	.....	49,800
40	Millstones.....	.....	200,000
41	Oilstones, etc.[a].....pounds..	420,000	8,000
42	Marls.....short tons..	1,000,000	500,000
43	Flint.....long tons..	20,000	80,000
44	Fluorspar.....short tons..	4,000	16,000
45	Chromic iron ore.....long tons..	2,288	27,808
46	Infusorial earth.....short tons..	1,833	45,660
47	Feldspar.....long tons..	12,500	60,000
48	Mica.....pounds..	81,669	127,825
49	Cobalt oxide.....do....	7,251	24,000
50	Slate ground as a pigment.....short tons..	1,000	10,000
51	Sulphur.....do....	600	21,000
52	Asbestos.....do....	150	4,312
53	Rutile.....pounds..	100	400
54	Lithographic stone.....short tons..	.....	.....
55	Total value of nonmetallic mineral products.....	.....	173,279,135
56	Total value of metallic products.....	.....	185,649,163
57	Estimated value of mineral products unspecified.....	.....	6,000,000
58	Grand total.....	.....	364,928,298

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

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for the calendar years 1880–1910.

1881.		1882.		1883.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,144,254	$87,029,334	4,623,323	$106,336,429	4,595,510	$91,910,200	1
33,257,800	37,657,500	36,196,900	41,105,900	35,732,800	39,618,400	2
1,678,612	34,700,000	1,572,187	32,500,000	1,451,250	30,000,000	3
71,680,000	12,175,600	91,646,232	16,038,091	117,151,795	18,064,807	4
117,085	11,240,160	132,890	12,624,550	143,957	12,322,719	5
26,800	2,680,000	33,765	3,646,620	36,872	3,311,106	6
60,851	1,764,679	52,732	1,487,042	46,725	1,253,632	7
265,668	292,235	281,616	309,777	58,800	52,920	8
				83	875	9
50	10,000	60	12,000	60	12,000	10
100	400	200	600	200	600	11
.....	187,549,908	.....	214,061,009	.....	196,547,259	12
48,179,475	60,224,344	60,361,190	76,076,487	68,531,500	82,237,800	13
28,500,016	64,125,036	31,358,264	70,556,094	34,336,469	77,257,055	14
.....	20,000,000	.....	21,000,000	.....	20,000,000	15
27,661,238	25,448,339	30,510,830	24,065,988	23,449,633	25,790,252	16
30,000,000	20,000,000	31,000,000	21,700,000	32,000,000	19,200,000	17
.....	.....	.....	215,000	.....	475,000	18
2,500,000	2,000,000	3,250,000	3,672,750	4,190,000	4,293,500	19
6,200,000	4,200,000	6,412,373	4,320,140	6,192,231	4,211,042	20
266,734	1,980,259	332,077	1,992,462	378,380	2,270,280	21
6,000,000	4,100,000	3,850,000	2,310,000	3,814,273	1,907,136	22
3,700,000	700,000	5,000,000	800,000	7,529,423	1,119,603	23
10,000	700,000	10,000	700,000	12,000	840,000	24
28,000	200,000	33,600	240,000	35,840	250,000	25
6,000	100,000	7,000	105,000	7,000	84,000	26
4,046,000	304,461	4,236,291	338,903	6,500,000	585,000	27
85,000	350,000	100,000	450,000	90,000	420,000	28
.....	500,000	.....	700,000	.....	600,000	29
5,000	60,000	6,000	75,000	6,000	75,000	30
10,000	60,000	12,000	72,000	25,000	137,500	31
7,000	75,000	6,000	90,000	8,000	150,000	32
4,895	73,425	4,532	67,980	6,155	92,325	33
2,000	8,000	3,000	10,500	3,000	10,500	34
.....	110,000	.....	150,000	.....	207,050	35
300,000	75,000	250,000	75,000	301,100	72,264	36
500	80,000	500	80,000	550	100,000	37
20,000	80,000	20,000	80,000	27,000	108,000	38
400,000	30,000	425,000	34,000	575,000	46,000	39
.....	150,000	.....	200,000	.....	150,000	40
500,000	8,580	600,000	10,000	600,000	10,000	41
1,000,000	500,000	1,080,000	540,000	972,000	486,000	42
25,000	100,000	25,000	100,000	25,000	100,000	43
4,000	16,000	4,000	20,000	4,000	20,000	44
2,000	30,000	2,500	50,000	3,000	60,000	45
1,000	10,000	1,000	8,000	1,000	5,000	46
14,000	70,000	14,000	70,000	14,100	71,112	47
100,000	250,000	100,000	250,000	114,000	285,000	48
8,280	25,000	11,653	32,046	1,096	2,795	49
1,000	10,000	2,000	24,000	2,000	24,000	50
600	21,000	600	21,000	1,000	27,000	51
200	7,000	1,200	36,000	1,000	30,000	52
200	700	500	1,800	550	2,000	53
50	1,000	.....	.....	.....	.....	54
.....	206,783,144	.....	231,340,150	.....	243,812,214	55
.....	187,549,908	.....	214,061,009	.....	196,547,259	56
.....	6,500,000	.....	6,500,000	.....	6,500,000	57
.....	400,833,052	.....	451,901,159	.....	446,859,473	58

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Mineral products of the United States for

	Product.	1884.	
		Quantity.	Value.
	METALS.		
1	Pig iron, value at Philadelphia ..... long tons..	4,097,868	$73,761,624
2	Silver, commercial value ..... troy ounces..	37,743,800	41,921,300
3	Gold, coining value ..... do....	1,489,950	30,800,000
4	Copper, value at New York City ..... pounds..	145,221,934	17,789,687
5	Lead, value at New York City ..... short tons..	139,897	10,537,042
6	Zinc, value at New York City ..... do....	38,544	3,422,707
7	Quicksilver, value at San Francisco ..... flasks..	31,913	936,327
8	Nickel, value at Philadelphia ..... pounds..	64,550	48,412
9	Aluminum, value at Pittsburg ..... do....	150	1,350
10	Antimony, value at San Francisco ..... short tons..	60	12,000
11	Platinum (crude), value at San Francisco ..... troy ounces..	150	450
12	Total value of metallic products	.....	179,230,899
	NONMETALS (SPOT VALUE).		
13	Bituminous coal ..... short tons..	73,730,539	77,417,066
14	Pennsylvania anthracite ..... long tons..	33,175,756	66,351,512
15	Stone	.....	19,000,000
16	Petroleum ..... barrels..	24,218,438	20,595,966
17	Lime ..... do....	37,000,000	18,500,000
18	Natural gas	.....	1,460,000
19	Brick clay	.....	.....
20	Clay (all other than brick) ..... short tons..	39,200	270,000
21	Cement ..... barrels..	4,000,000	3,720,000
22	Salt ..... do....	6,514,937	4,197,734
23	Phosphate rock ..... long tons..	431,779	2,374,784
24	Limestone for iron flux ..... do....	3,401,930	1,700,965
25	Mineral waters ..... gallons sold..	10,215,328	1,459,143
26	Zinc white ..... short tons..	13,000	910,000
27	Mineral paints ..... do....	7,000	84,000
28	Borax ..... pounds..	7,000,000	490,000
29	Gypsum ..... short tons..	90,000	390,000
30	Grindstones	.....	570,000
31	Fibrous talc ..... short tons..	10,000	110,000
32	Pyrite ..... long tons..	35,000	175,000
33	Soapstone ..... short tons..	10,000	200,000
34	Manganese ore ..... long tons..	10,180	122,160
35	Asphalt ..... short tons..	3,000	10,500
36	Precious stones	.....	222,975
37	Bromine ..... pounds..	281,100	67,464
38	Corundum ..... short tons..	600	108,000
39	Barytes (crude) ..... do....	25,000	100,000
40	Graphite ..... pounds..	.....	.....
41	Millstones	.....	150,000
42	Oilstones, etc.[a] ..... pounds..	800,000	12,000
43	Marls ..... short tons..	875,000	437,500
44	Flint ..... long tons..	30,000	120,000
45	Fluorspar ..... short tons..	4,000	20,000
46	Chromic iron ore ..... long tons..	2,000	35,000
47	Infusorial earth ..... short tons..	1,000	5,000
48	Feldspar ..... long tons..	10,900	55,112
49	Mica ..... pounds..	147,410	368,525
50	Colbalt oxide ..... do....	2,000	5,100
51	Slate ground as a pigment ..... short tons..	2,000	20,000
52	Sulphur ..... do....	500	12,000
53	Asbestos ..... do....	1,000	30,000
54	Rutile ..... pounds..	600	2,000
55	Lithographic stone ..... short tons..	.....	.....
56	Total value of nonmetallic mineral products	.....	221,879,506
57	Total value of metallic products	.....	179,230,899
58	Estimated value of mineral products unspecified	.....	5,000,000
59	Grand total	.....	406,110,405

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

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the calendar years 1880–1910—Continued.

1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,044,425	$64,712,400	5,683,329	$95,195,760	6,417,148	$121,925,800	1
39,909,400	42,503,500	39,694,000	39,482,400	41,721,600	40,887,200	2
1,538,373	31,801,000	1,686,788	34,869,000	1,603,049	33,136,000	3
170,962,607	18,292,999	161,235,381	16,527,651	185,227,331	21,115,916	4
129,412	10,469,431	130,629	12,200,749	145,700	13,113,000	5
40,668	3,539,856	42,641	3,752,408	50,340	4,782,300	6
32,073	979,189	29,981	1,060,000	33,825	1,429,000	7
277,904	179,975	214,992	127,157	205,566	133,200	8
283	2,550	3,000	27,000	18,000	59,000	9
50	10,000	35	7,000	75	15,000	10
250	187	50	100	448	1,838	11
.....	172,491,087	.....	203,249,225	.....	236,598,254	12
64,840,668	82,347,648	73,707,957	78,481,056	87,887,360	98,004,656	13
34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	14
.....	19,000,000	.....	19,000,000	.....	25,000,000	15
21,847,205	19,198,243	28,064,841	19,996,313	28,278,866	18,877,094	16
40,000,000	20,000,000	.....	.....	.....	.....	17
.....	4,857,200	.....	10,012,000	.....	15,817,500	18
.....	.....	.....	6,200,000	.....	7,000,000	19
40,320	275,000	44,800	325,000	48,160	340,000	20
4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,674,377	21
7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,846	22
437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	23
3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	24
9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,463	25
15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	26
3,950	43,575	18,800	315,000	22,000	330,000	27
8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	28
90,405	405,000	95,250	428,625	95,000	425,000	29
.....	500,000	.....	250,000	.....	224,400	30
10,000	110,000	12,000	125,000	15,000	160,000	31
49,000	220,500	55,000	220,000	52,000	210,000	32
10,000	200,000	12,000	225,000	12,000	225,000	33
23,258	190,281	30,193	277,636	34,524	333,844	34
3,000	10,500	3,500	14,000	4,000	16,000	35
.....	209,900	.....	119,056	.....	163,600	36
310,000	89,900	428,334	141,350	199,087	61,717	37
600	108,000	645	116,190	600	108,000	38
15,000	75,000	10,000	50,000	15,000	75,000	39
327,883	26,231	415,525	33,242	416,000	34,000	40
.....	100,000	.....	140,000	.....	100,000	41
1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	42
875,000	437,500	800,000	400,000	600,000	300,000	43
30,000	120,000	30,000	120,000	32,000	128,000	44
5,000	22,500	5,000	22,000	5,000	20,000	45
2,700	40,000	2,000	30,000	3,000	40,000	46
1,000	5,000	1,200	6,000	3,000	15,000	47
13,600	68,000	14,900	74,500	10,200	61,200	48
92,000	161,000	40,000	70,000	70,000	142,250	49
68,723	65,373	35,000	36,878	18,340	18,774	50
1,975	24,687	.....	.....	.....	.....	51
715	17,875	2,500	75,000	3,000	100,000	52
300	9,000	200	6,000	150	4,500	53
600	2,000	600	2,000	1,000	3,000	54
.....	.....	.....	.....	.....	.....	55
.....	241,312,093	.....	230,088,769	.....	270,989,420	56
.....	172,491,087	.....	203,249,225	.....	236,598,254	57
.....	5,000,000	.....	800,000	.....	800,000	58
.....	418,803,180	.....	434,137,994	.....	508,387 674	59

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Mineral products of the United States for

	Product.	1888.	
		Quantity.	Value.
	METALS.		
1	Pig iron, value at Philadelphia....long tons..	6,489,738	$107,000,000
2	Silver, commercial value....troy ounces..	45,792,700	43,045,100
3	Gold, coining value....do....	1,604,478	33,167,500
4	Copper, value at New York City....pounds..	231,270,622	33,833,954
5	Lead, value at New York City....short tons..	151,919	13,399,256
6	Zinc, value at New York City....do....	55,903	5,500,855
7	Quicksilver, value at San Francisco....flasks..	33,250	1,413,125
8	Aluminum, value at Pittsburg....pounds..	19,000	65,000
9	Antimony, value at San Francisco....short tons..	100	20,000
10	Nickel, value at Philadelphia....pounds..	204,328	127,632
11	Tin....do....	.....	.....
12	Platinum (crude), value at San Francisco....troy ounces..	500	2,000
13	Total value of metallic products....	.....	237,574,422
	NONMETALS (SPOT VALUE).		
14	Bituminous coal....short tons..	102,039,838	101,860,529
15	Pennsylvania anthracite....long tons..	41,624,611	89,020,483
16	Stone....	.....	25,500,000
17	Petroleum....barrels..	27,612,025	17,947,620
18	Natural gas....	.....	22,629,875
19	Brick clay....	.....	7,500,000
20	Clay (all other than brick)....short tons..	41,160	300,000
21	Cement....barrels..	6,503,295	5,021,130
22	Mineral waters....gallons sold..	9,578,648	1,679,302
23	Phosphate rock....long tons..	448,567	2,018,552
24	Salt....barrels..	8,055,881	4,374,203
25	Limestone for iron flux....long tons..	5,438,000	2,719,000
26	Zinc white....short tons..	20,000	1,600,000
27	Gypsum....do....	110,000	550,000
28	Borax....pounds..	7,589,000	455,340
29	Mineral paints....short tons..	26,500	405,000
30	Grindstones....	.....	281,800
31	Fibrous talc....short tons..	20,000	210,000
32	Asphalt....do....	53,800	331,500
33	Soapstone....do....	15,000	250,000
34	Precious stones....	.....	139,850
35	Pyrite....long tons..	54,331	167,658
36	Corundum....short tons..	589	91,620
37	Oilstones, etc.[a]....pounds..	1,500,000	18,000
38	Mica....do....	48,000	70,000
39	Barytes (crude)....short tons..	20,000	110,000
40	Bromine....pounds..	307,386	95,290
41	Fluorspar....short tons..	6,000	30,000
42	Feldspar....long tons..	8,700	50,000
43	Manganese ore....do....	29,198	279,571
44	Flint....do....	30,000	127,500
45	Graphite....pounds..	400,000	33,000
46	Bauxite....long tons..	.....	.....
47	Sulphur....short tons..	.....	.....
48	Marls....do....	300,000	150,000
49	Infusorial earth....do....	1,500	7,500
50	Millstones....	.....	81,000
51	Chromic iron ore....long tons..	1,500	20,000
52	Cobalt oxide....pounds..	8,491	15,782
53	Magnesite....short tons..	.....	.....
54	Asbestos....do....	100	3,000
55	Rutile....pounds..	1,000	3,000
56	Ozokerite (refined)....do....	43,500	3,000
57	Total value of nonmetallic mineral products....	.....	286,150,114
58	Total value of metallic products....	.....	237,574,422
59	Estimated value of mineral products unspecified....	.....	900,000
60	Grand total....	.....	524,624,536

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

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the calendar years 1880–1910—Continued.

1889.		1890.		1891.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,387,985	1
50,094,500	46,838,400	54,516,300	57,242,100	58,330,000	57,630,000	2
1,594,775	32,967,000	1,588,877	32,845,000	1,604,840	33,175,000	3
231,246,214	26,907,809	265,115,133	30,848,797	295,812,076	38,455,300	4
156,397	13,794,235	143,630	12,668,166	178,554	15,534,198	5
58,860	5,791,824	63,683	6,266,407	80,873	8,033,700	6
26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	7
47,468	97,335	61,281	61,281	150,000	100,000	8
115	28,000	938	177,508	1,289	217,957	9
252,663	151,598	223,488	134,093	118,498	71,099	10
.....	.....	.....	.....	125,289	25,058	11
500	2,000	600	2,500	100	500	12
.....	247,768,701	.....	292,649,877	.....	282,617,183	13
95,685,543	94,504,745	111,320,016	110,420,801	117,901,237	117,188,400	14
40,714,721	65,879,514	41,499,858	66,383,772	45,236,992	73,944,735	15
.....	42,809,706	.....	47,000,000	.....	47,294,740	16
35,163,513	26,963,340	45,822,672	35,365,105	54,291,980	30,526,553	17
.....	21,097,099	.....	18,792,725	.....	15,500,084	18
.....	8,000,000	.....	8,500,000	.....	9,000,000	19
329,666	635,578	392,000	756,000	448,000	900,000	20
7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	21
12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	22
560,245	2,937,776	510,499	3,213,795	587,988	3,651,150	23
8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	24
6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	25
16,970	1,357,600	.....	1,600,000	23,700	1,600,000	26
267,769	764,118	182,995	574,523	208,126	628,051	27
8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	28
34,307	483,766	47,732	681,992	49,652	678,478	29
.....	439,587	.....	450,000	.....	476,113	30
23,746	244,170	41,354	389,196	53,054	493,068	31
51,735	171,537	40,841	190,416	45,054	242,364	32
12,715	231,708	13,670	252,309	16,514	243,981	33
.....	188,807	.....	118,833	.....	235,300	34
93,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,395	2,765	90,230	36
5,982,000	32,980	.....	69,909	1,375,000	150,000	37
49,500	50,000	60,000	75,000	75,000	100,000	38
19,161	106,313	21,911	86,805	31,069	118,363	39
418,891	125,667	387,847	104,719	343,000	54,880	40
9,500	45,835	8,250	55,328	10,044	78,330	41
6,970	39,370	8,000	45,200	10,000	50,000	42
24,197	240,559	25,684	219,050	23,416	239,129	43
21,113	89,720	13,000	57,400	15,000	60,000	44
.....	72,662	.....	77,500	.....	110,000	45
728	2,366	1,844	6,012	3,593	11,675	46
1,150	7,880	.....	.....	1,200	39,600	47
139,522	63,956	153,620	69,880	135,000	67,500	48
3,466	23,372	2,532	50,240	.....	21,988	49
.....	35,155	.....	23,720	.....	16,587	50
2,000	30,000	3,599	53,985	1,372	20,580	51
13,955	31,092	6,788	16,291	7,200	18,000	52
.....	.....	.....	.....	439	4,390	53
30	1,800	71	4,560	66	3,390	54
1,000	3,000	400	1,000	300	800	55
50,000	2,500	350,000	26,250	50,000	7,000	56
.....	282,623,812	.....	312,826,503	.....	321,767,846	57
.....	247,768,701	.....	292,649,877	.....	282,617,183	58
.....	1,000,000	.....	1,000,000	.....	1,000,000	59
.....	531,392,513	.....	606,476,380	.....	605,385,029	60

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Mineral products of the United States for

	Product.	1892. Quantity.	1892. Value.
	METALS.		
1	Pig iron, spot value.....long tons..	9,157,000	$131,161,039
2	Silver, commercial value.....troy ounces..	63,500,000	55,662,500
3	Gold, coining value.....do....	1,597,098	33,015,000
4	Copper, value at New York City.....pounds..	352,971,744	37,977,142
5	Lead, value at New York City.....short tons..	173,654	13,892,320
6	Zinc, value at New York City.....do....	87,260	8,027,920
7	Quicksilver, value at San Francisco.....flasks..	27,993	1,245,689
8	Aluminum, value at Pittsburg.....pounds..	259,885	172,824
9	Antimony, value at San Francisco.....short tons..	1,790	276,416
10	Nickel, value at Philadelphia.....pounds..	92,252	50,739
11	Tin.....do....	162,000	32,400
12	Platinum, value (crude) at San Francisco.....troy ounces..	80	550
13	Total value of metallic products.....	.....	281,514,539
	NONMETALS (SPOT VALUE).		
14	Bituminous coal.....short tons..	126,856,567	125,124,381
15	Pennsylvania anthracite.....long tons..	46,850,450	82,442,000
16	Natural gas.....	.....	14,870,714
17	Petroleum.....barrels..	50,509,136	26,034,196
18	Brick clay.....	.....	9,000,000
19	Cement.....barrels..	8,758,621	7,152,750
20	Stone.....	.....	48,706,625
21	Corundum and emery.....short tons..	1,771	181,300
22	Crystalline quartz.....do....	.....	.....
23	Garnet for abrasive purposes.....do....	.....	.....
24	Grindstones.....	.....	272,244
25	Infusorial earth and tripoli.....short tons..	.....	43,655
26	Millstones.....	.....	23,417
27	Oilstones, etc.....	.....	146,730
28	Borax.....pounds..	13,500,000	900,000
29	Bromine.....do....	379,480	64,502
30	Fluorspar.....short tons..	12,250	89,000
31	Gypsum.....do....	256,259	695,492
32	Marls.....do....	125,000	65,000
33	Phosphate rock.....long tons..	681,571	3,296,227
34	Pyrite.....do....	109,788	305,191
35	Salt.....barrels..	11,698,890	5,654,915
36	Sulphur.....short tons..	2,688	80,640
37	Barytes (crude).....do....	32,108	130,025
38	Cobalt oxide.....pounds..	7,869	15,738
39	Mineral paints.....short tons..	51,704	767,766
40	Zinc white.....do....	27,500	2,200,000
41	Asbestos.....do....	104	6,416
42	Asphalt.....do....	87,680	445,375
43	Bauxite.....long tons..	10,518	34,183
44	Chromic iron ore.....do....	1,500	25,000
45	Clay (all other than brick).....short tons..	470,400	1,000,000
46	Feldspar.....do....	16,800	75,000
47	Fibrous talc.....do....	41,925	472,485
48	Flint.....do....	22,400	80,000
49	Fuller's earth.....do....	.....	.....
50	Graphite.....pounds..	.....	104,000
51	Limestone for iron flux.....long tons..	5,172,114	3,620,480
52	Magnesite.....short tons..	1,004	10,040
53	Manganese ore.....long tons..	13,613	129,586
54	Mica.....pounds..	75,000	100,000
55	Mineral waters.....gallons sold..	21,876,604	4,906,970
56	Monazite.....pounds..	.....	.....
57	Ozokerite (refined).....do....	60,000	8,000
58	Precious stones.....	.....	312,050
59	Pumice stone.....short tons..	.....	.....
60	Rutile.....pounds..	100	300
61	Soapstone.....short tons..	23,908	437,449
62	Total value of nonmetallic mineral products.....	.....	340,028,842
63	Total value of metallic products.....	.....	281,514,539
64	Estimated value of mineral products unspecified.....	.....	1,000,000
65	Grand total.....	.....	622,543,381

* Including copper made from imported pyrites.

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the calendar years 1880–1910—Continued.

1893.		1894.		1895.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,124,502	$84,810,426	6,657,388	$65,007,247	9,446,308	$105,198,550	1
60,000,000	46,800,000	49,500,000	31,422,100	55,727,000	36,445,500	2
1,739,323	35,955,000	1,910,813	39,500,000	2,254,760	46,610,000	3
339,785,972	32,054,601	364,866,908	33,141,142	[a] 385,913,404	38,012,470	4
163,982	11,839,590	159,331	9,942,254	170,000	11,220,000	5
78,832	6,306,560	75,328	5,288,026	89,686	6,278,020	6
30,164	1,108,527	30,416	934,000	36,104	1,337,131	7
339,629	266,903	550,000	316,250	920,000	464,600	8
1,503	270,540	1,387	249,706	2,013	304,169	9
49,399	22,197	9,616	3,269	10,302	3,091	10
8,938	1,788	.....	.....	.....	.....	11
75	517	100	600	150	900	12
.....	219,436,649	.....	185,804,594	.....	245,874,431	13
128,385,231	122,751,618	118,820,405	107,653,501	135,118,193	115,779,771	14
48,185,306	85,687,078	46,358,144	78,488,063	51,785,122	82,019,272	15
.....	14,346,250	.....	13,954,400	.....	13,006,650	16
48,412,666	28,932,326	49,344,516	35,522,095	52,892,276	57,632,298	17
.....	9,000,000	.....	[b] 64,655,388	.....	[b] 65,409,806	18
8,002,467	6,262,841	8,362,245	5,030,061	8,731,401	5,482,254	19
.....	33,885,573	.....	36,534,788	.....	33,319,131	20
1,713	142,325	1,495	95,936	2,102	106,256	21
.....	.....	6,024	18,054	9,000	27,000	22
.....	.....	.....	.....	3,325	95,050	23
.....	338,787	.....	223,214	.....	205,768	24
.....	22,582	2,584	11,718	4,964	20,514	25
.....	16,645	.....	13,887	.....	22,542	26
.....	135,173	.....	136,873	.....	155,881	27
8,699,000	652,425	14,680,130	974,445	11,918,000	595,900	28
348,399	104,520	379,444	102,450	517,421	134,343	29
12,400	84,000	7,500	47,500	4,000	24,000	30
253,615	696,615	239,312	761,719	265,503	797,447	31
75,000	40,000	75,000	40,000	60,000	30,000	32
941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094	33
75,777	256,552	105,940	363,134	99,549	322,845	34
11,816,772	4,054,668	12,967,417	4,739,285	13,669,649	4,423,084	35
1,200	42,000	500	20,000	1,800	42,000	36
28,970	88,506	23,335	86,983	21,529	68,321	37
8,422	10,346	6,763	10,145	14,458	20,675	38
37,724	530,384	41,926	498,093	50,695	621,552	39
24,059	1,804,420	19,987	1,399,090	20,710	1,449,700	40
50	2,500	325	4,463	795	13,525	41
47,779	372,232	60,570	353,400	68,163	348,281	42
9,079	29,507	11,066	35,818	17,069	44,000	43
1,450	21,750	3,680	53,231	1,740	16,795	44
448,000	900,000	.....	.....	.....	.....	45
20,578	68,307	19,264	167,000	8,523	30,000	46
35,861	403,436	39,906	435,060	39,240	370,897	47
33,231	63,792	42,560	319,200	13,747	21,038	48
.....	.....	.....	.....	6,900	41,400	49
843,103	63,232	918,000	64,010	.....	52,582	50
3,968,055	2,374,833	3,696,550	1,849,275	5,247,949	2,623,974	51
704	7,040	1,440	10,240	2,220	17,000	52
7,718	66,614	6,308	53,635	9,547	71,769	53
66,971	88,929	.....	52,388	.....	55,831	54
23,544,495	4,246,734	21,569,608	3,741,846	21,463,543	4,254,237	55
130,000	7,600	546,855	36,193	1,573,000	137,150	56
.....	.....	.....	.....	.....	.....	57
.....	264,041	.....	132,250	.....	113,621	58
.....	.....	.....	.....	.....	.....	59
.....	.....	150	450	100	350	60
21,071	255,067	23,144	401,325	21,495	266,495	61
.....	323,257,318	.....	362,570,173	.....	393,897,097	62
.....	219,436,649	.....	185,804,594	.....	245,874,431	63
.....	1,000,000	.....	1,000,000	.....	1,000,000	64
.....	543,693,967	.....	549,374,767	.....	640,771,528	65

[b] Clay products.

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Mineral products of the United States for

	Product.	1896. Quantity.	1896. Value.
	METALS.		
1	Pig iron, spot value.....long tons..	8,623,127	$90,250,000
2	Silver, commercial value.....troy ounces..	58,834,900	39,654,600
3	Gold, coining value.....do....	2,568,132	53,088,000
4	Copper, value at New York City.....pounds..	460,061,430	49,456,603
5	Lead, value at New York City.....short tons..	188,000	10,528,000
6	Zinc, value at New York City.....do....	81,499	6,519,920
7	Quicksilver, value at San Francisco.....flasks..	30,765	1,075,449
8	Aluminum, value at Pittsburg.....pounds..	1,300,000	520,000
9	Antimony, value at San Francisco.....short tons..	2,478	347,539
10	Nickel, value at Philadelphia.....pounds..	17,170	4,464
11	Tin.....do....	.....	.....
12	Platinum, value (crude) at New York City.....troy ounces..	163	944
13	Total value of metallic products.....	.....	251,445,519
	NONMETALS (SPOT VALUE).		
14	Bituminous coal.....short tons..	137,640,276	114,891,515
15	Pennsylvania anthracite.....long tons..	48,523,287	81,748,651
16	Natural gas.....	.....	13,002,512
17	Petroleum.....barrels..	60,960,361	58,518,709
18	Clay products.....	.....	63,110,408
19	Cement.....barrels..	9,513,473	6,473,213
20	Lime.....	.....	6,327,900
21	Slate.....	.....	2,746,205
22	Stone.....	.....	23,965,229
23	Corundum and emery.....short tons..	2,120	113,246
24	Crystalline quartz.....do....	6,000	18,000
25	Garnet for abrasive purposes.....do....	2,686	68,877
26	Grindstones.....	.....	326,826
27	Infusorial earth and tripoli.....short tons..	3,846	26,792
28	Millstones.....	.....	22,567
29	Oilstones, etc.....	.....	127,098
30	Borax.....pounds..	13,508,000	675,400
31	Bromine.....do....	546,580	144,501
32	Fluorspar.....short tons..	6,500	52,000
33	Gypsum.....do....	224,254	573,344
34	Marls.....do....	60,000	30,000
35	Phosphate rock.....long tons..	930,779	2,903,372
36	Pyrite.....do....	115,483	320,163
37	Salt.....barrels..	13,850,726	4,040,839
38	Sulphur.....short tons..	5,260	87,200
39	Barytes (crude).....do....	17,068	46,513
40	Cobalt oxide.....pounds..	10,700	15,301
41	Mineral paints.....short tons..	43,894	459,080
42	Zinc white.....do....	20,000	1,400,000
43	Asbestos.....do....	504	6,100
44	Asphalt.....do....	80,503	577,563
45	Bauxite.....long tons..	18,364	47,338
46	Chromic iron ore.....do....	786	6,667
47	Feldspar.....short tons..	10,203	35,200
48	Fibrous talc.....do....	46,089	399,443
49	Fuller's earth.....do....	9,872	59,360
50	Graphite (crystalline).....pounds..	535,858	48,460
51	Graphite (amorphous).....short tons..	760	
52	Magnesite.....do....	1,500	11,000
53	Manganese ore.....long tons..	10,088	90,727
54	Mica (sheet).....pounds..	49,156	65,441
55	Mica (scrap).....short tons..	222	1,750
56	Mineral waters.....gallons sold..	25,795,312	4,136,192
57	Monazite.....pounds..	30,000	1,500
58	Ozokerite (refined).....do....	.....	.....
59	Precious stones.....	.....	97,850
60	Pumice stone.....short tons..	.....	.....
61	Quartz (flint).....do....	12,458	24,226
62	Rutile.....pounds..	100	350
63	Soapstone.....short tons..	22,183	354,065
64	Total value of nonmetallic mineral products.....	.....	388,098,702
65	Total value of metallic products.....	.....	251,445,519
66	Estimated value of mineral products unspecified.....	.....	1,000,000
67	Grand total.....	.....	640,544,221

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the calendar years 1880–1910—Continued.

1897.		1898.		1899.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
9,652,680	$95,122,299	11,773,934	$116,557,000	13,620,703	$245,172,654	1
53,860,000	32,316,000	54,438,000	32,118,400	54,764,500	32,858,700	2
2,774,935	57,363,000	3,118,398	64,453,000	3,437,210	71,053,400	3
494,078,274	54,080,180	526,512,987	61,865,276	568,666,921	101,222,712	4
212,000	14,885,728	222,000	16,650,000	210,500	18,945,000	5
99,980	8,498,300	115,399	10,385,910	129,051	14,840,865	6
26,648	993,445	31,092	1,188,627	30,454	1,452,745	7
4,000,000	1,500,000	5,200,000	1,716,000	6,500,000	1,716,000	8
3,061	442,300	3,238	532,101	2,861	559,189	9
23,707	7,823	11,145	3,956	22,541	8,566	10
						11
150	900	225	1,913	300	1,800	12
	265,209,975		305,482,183		487,831,631	13
147,617,519	119,595,224	166,593,623	132,608,713	193,323,187	167,952,104	14
46,974,714	79,301,954	47,663,076	75,414,537	53,944,647	88,142,130	15
	13,826,422		15,296,813		20,074,873	16
60,475,516	40,874,072	55,364,233	44,193,359	57,070,850	64,603,904	17
	62,359,991		74,487,680		95,797,370	18
10,999,463	8,178,283	12,111,208	9,859,501	15,520,445	12,889,142	19
	6,390,487		6,886,549		6,983,067	20
	3,524,614		3,723,540		3,962,733	21
	26,876,671		28,635,175		35,244,717	22
2,165	106,574	4,064	275,064	4,900	150,600	23
7,500	22,500	8,312	23,990	13,600	39,000	24
2,554	80,853	2,967	86,850	2,765	98,325	25
	368,058		489,769		675,586	26
3,833	22,835	2,733	16,691	4,334	37,032	27
	25,932		25,934		28,115	28
	149,970		180,486		208,283	29
16,000,000	1,080,000	16,000,000	1,120,000	40,714,000	1,139,882	30
487,149	129,094	486,979	126,614	433,004	108,251	31
5,062	37,159	7,675	63,050	15,900	96,650	32
238,982	755,864	291,638	755,280	486,235	1,287,080	33
60,000	30,000	60,000	30,000	60,000	30,000	34
1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	35
143,201	391,541	193,364	593,801	174,734	543,249	36
15,973,202	4,920,020	17,612,634	6,212,554	19,708,614	6,867,467	37
2,275	45,590	1,200	32,960	4,830	107,500	38
26,042	58,295	31,306	108,339	41,894	139,528	39
19,520	31,232	6,247	9,371	10,230	18,512	40
47,308	501,029	48,479	534,345	51,020	517,328	41
25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	42
580	6,450	605	10,300	681	11,740	43
75,945	664,632	76,337	675,649	75,085	653,904	44
20,590	57,652	25,149	75,437	35,280	125,598	45
						46
12,516	43,100	13,440	32,396	24,202	211,545	47
57,009	396,936	54,356	411,430	54,655	438,150	48
17,113	112,272	14,860	106,500	12,381	79,644	49
1,361,706	65,730	2,360,000	75,200	2,900,732	167,106	50
1,070		890		2,324		51
1,143	13,671	1,263	19,075	1,280	18,480	52
11,108	95,505	15,957	129,185	9,935	82,278	53
82,676	80,774	129,520	103,534	108,570	70,587	54
740	14,452	3,999	27,564	1,505	50,878	55
23,255,911	4,599,106	28,853,464	8,051,833	39,562,136	6,948,030	56
44,000	1,980	250,776	13,542	350,000	20,000	57
						58
	130,675		160,920		185,770	59
158		600	13,200	400	10,000	60
13,466	26,227	21,425	42,670	29,852	180,345	61
100	350	140	700	230	1,030	62
21,923	365,629	22,231	287,112	24,765	330,805	63
	380,782,607		417,790,671		525,524,074	64
	265,209,975		305,482,183		487,831,631	65
	1,000,000		1,000,000		1,000,000	66
	646,992,582		724,272,854		1,014,355,705	67

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Mineral products of the United States for

	Product.	1900. Quantity.	1900. Value.
	METALS.		
1	Pig iron, value at Philadelphia....long tons..	13,789,242	$259,944,000
2	Silver, commercial value....troy ounces..	57,647,000	35,741,100
3	Gold, coining value....do....	3,829,897	79,171,000
4	Copper, value at New York City....pounds..	606,117,166	98,494,039
5	Lead, value at New York City....short tons..	270,824	23,561,688
6	Zinc, value at New York City....do....	123,886	10,654,196
7	Quicksilver, value at San Francisco....flasks..	28,317	1,302,586
8	Aluminum, value at Pittsburg....pounds..	7,150,000	1,920,000
9	Antimony, value at San Francisco....short tons..	4,226	837,896
10	Nickel, value at Philadelphia....pounds..	9,715	3,886
11	Tin....do....	.....	.....
12	Platinum, value (crude) at New York City....troy ounces..	400	2,500
13	Total value of metallic products....	.....	511,632,891
	NONMETALS (SPOT VALUE).		
14	Bituminous coal....short tons..	212,316,112	220,930,313
15	Pennsylvania anthracite....long tons..	51,221,353	85,757,851
16	Natural gas....	.....	23,698,674
17	Petroleum....barrels..	63,620,529	75,980,313
18	Clay products....	.....	96,212,345
19	Cement....barrels..	17,231,150	13,283,581
20	Lime....	.....	6,797,496
21	Sand-lime brick....	.....	.....
22	Slate....	.....	4,240,466
23	Stone....	.....	36,970,777
24	Corundum and emery....short tons..	4,305	102,715
25	Crystalline quartz....do....	14,461	40,705
26	Garnet for abrasive purposes....do....	3,185	123,475
27	Grindstones....	.....	710,026
28	Infusorial earth and tripoli....short tons..	3,615	24,207
29	Millstones....	.....	32,858
30	Oilstones, etc....	.....	174,087
31	Arsenious oxide....pounds..	.....	.....
32	Borax....short tons..	[a] 1,602 [b] 24,235	170,036 848,215
33	Bromine....pounds..	521,444	140,790
34	Fluorspar....short tons..	18,450	94,500
35	Gypsum....do....	594,462	1,627,203
36	Lithium....do....	520	.....
37	Marls....do....	60,000	30,000
38	Phosphate rock....long tons..	1,491,216	5,359,248
39	Pyrite....do....	204,615	749,991
40	Sulphur....short tons..	3,525	88,100
41	Salt....barrels..	20,899,342	6,944,603
42	Barytes (crude)....short tons..	67,680	188,089
43	Cobalt oxide....pounds..	6,471	11,648
44	Mineral paints....short tons..	57,426	644,089
45	Zinc white....do....	48,840	3,667,210
46	Asbestos....do....	1,054	16,310
47	Asphalt....do....	54,389	415,958
48	Bauxite....long tons..	23,184	89,676
49	Chromic iron ore....do....	140	1,400
50	Feldspar....short tons..	24,821	180,971
51	Fibrous talc....do....	63,500	499,500
52	Fuller's earth....do....	9,698	67,535
53	Glass sand....do....	.....	.....
54	Graphite (crystalline)....pounds..	5,507,855	197,579
55	Graphite (amorphous)....short tons..	611	
56	Magnesite....do....	2,252	19,333
57	Manganese ore....long tons..	11,771	100,289
58	Mica (sheet)....pounds..	456,283	92,758
59	Mica (scrap)....short tons..	5,497	55,202
60	Mineral waters....gallons sold..	47,558,784	6,245,172
61	Monazite and zircon....pounds..	908,000	43,805
62	Precious stones....	.....	233,170
63	Pumice stone....short tons..	.....	.....
64	Quartz (flint)....do....	32,495	86,351
65	Rutile....pounds..	300	1,300
66	Talc and soapstone....short tons..	27,943	383,541
67	Tungsten....do....	46	11,040
68	Uranium and vanadium....do....	.....	.....
69	Total value of nonmetallic mineral products....	.....	594,398,501
70	Total value of metallic products....	.....	511,632,891
71	Estimated value of mineral products unspecified....	.....	1,000,000
72	Grand total....	.....	1,107,031,392

[a] No metallic tin; about 20 tons of high-grade concentrates shipped to England from South Carolina.

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the calendar years 1880–1910—Continued.

1901.		1902.		1903.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
15,878,354	$242,174,000	17,821,307	$372,775,000	18,009,252	$344,350,000	1
55,214,000	33,128,400	55,500,000	29,415,000	54,300,000	29,322,000	2
3,805,500	78,666,700	3,870,000	80,000,000	3,560,000	73,591,700	3
602,072,519	87,300,515	659,508,644	76,568,954	698,044,517	91,506,006	4
270,700	23,280,200	270,000	22,140,000	282,000	23,520,000	5
140,822	11,265,760	156,927	14,625,596	159,219	16,717,995	6
29,727	1,382,305	34,291	1,467,848	35,620	1,544,034	7
7,150,000	2,238,000	7,300,000	2,284,590	7,500,000	2,284,900	8
2,639	539,902	3,561	634,506	3,128	548,433	9
6,700	3,551	5,748	2,701	114,200	45,900	10
				(a)		11
1,408	27,526	94	1,814	110	2,080	12
	480,006,859		599,916,009		583,433,948	13
225,828,149	236,422,049	260,216,844	290,858,483	282,749,348	351,687,933	14
60,242,560	112,504,020	36,940,710	76,173,586	66,613,454	152,036,448	15
	27,066,077		30,867,863		35,807,860	16
69,389,194	66,417,335	88,766,916	71,178,910	100,461,337	94,694,050	17
	110,211,587		122,169,531		131,062,421	18
20,068,737	15,786,789	25,753,504	25,366,380	29,899,140	31,931,341	19
	8,204,054		9,335,618		9,255,882	20
					155,040	21
	4,787,525		5,696,051		6,256,885	22
	47,284,183		54,798,682		57,433,141	23
4,305	146,040	4,251	104,605	2,542	64,102	24
14,050	41,500	15,104	84,335	8,938	76,908	25
4,444	158,100	3,926	132,820	3,950	132,500	26
	580,703		667,431		721,446	27
4,020	52,950	5,665	53,244	9,219	76,273	28
	57,179		59,808		52,552	29
	158,300		221,762		366,857	30
600,000	18,000	2,706,000	81,180	1,222,000	36,691	31
b 5,344	697,307	b 17,404	2,447,614	c 34,430	661,400	32
c 17,887	314,811	c 2,600	91,000			
552,043	154,572	513,893	128,472	598,500	167,580	33
19,586	113,803	46,018	271,832	42,523	213,617	34
633,791	1,506,641	816,478	2,089,341	1,041,704	3,792,943	35
1,750	43,200	1,245	25,750	1,155	23,425	36
99,880	124,880	12,439	12,741	34,211	22,521	37
1,493,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294	38
241,691	1,257,879	207,874	947,089	d 233,127	1,109,818	39
(d)	(d)	(d)	(d)			40
20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988	41
49,070	157,844	61,668	203,154	50,397	152,150	42
13,360	24,048	3,730	6,714	120,000	228,000	43
52,209	636,145	60,191	745,227	56,262	500,922	44
46,500	3,720,000	52,645	4,016,499	62,962	4,801,718	45
747	13,498	1,005	16,200	887	16,760	46
63,134	555,335	105,458	765,048	101,255	1,005,446	47
18,905	79,914	27,322	120,366	48,087	171,306	48
368	5,790	315	4,567	150	2,250	49
34,741	220,422	45,287	250,424	41,891	256,733	50
69,200	483,600	71,100	615,350	60,230	421,600	51
14,112	96,835	11,492	98,144	20,693	190,277	52
		943,135	807,797	823,044	855,828	53
3,967,612	167,714	3,936,824	182,108	4,538,155	225,554	54
809		4,739		16,591		55
3,500	10,500	2,830	8,490	3,744	10,595	56
11,995	116,722	7,477	60,911	2,825	25,335	57
360,060	98,859	373,266	83,843	619,600	118,088	58
2,171	19,719	1,400	35,006	1,659	25,040	59
54,733,661	7,443,904	63,174,552	8,634,179	40,107,147	6,788,426	60
748,736	59,262	802,000	64,160	865,000	65,200	61
	289,050		328,450		307,900	62
		700	2,750	885	2,665	63
34,420	149,297	36,365	144,209	55,233	156,947	64
44,250	5,710	(e)				65
28,643	424,888	26,854	525,157	26,671	418,460	66
179	27,720	184	34,040	292	43,639	67
375		3,810	48,125	30	5,625	68
	660,850,112		722,027,126		905,242,380	69
	480,006,859		599,916,009		583,433,948	70
	1,000,000		1,000,000		1,000,000	71
	1,141,856,971		1,322,943,135		1,489,676,328	72

b Refined. c Crude. d Included under pyrite. e Included under estimated unspecified products.

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Mineral products of the United States for the calendar years 1880–1910—Continued.

Product.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
METALS.				
Pig iron (spot value)....long tons..	16,497,033	$233,025,000	22,992,380	$382,450,000
Silver, commercial value....troy ounces..	57,682,800	33,456,000	56,101,600	34,221,976
Gold, coining value....do....	3,892,480	80,464,700	4,265,742	88,180,700
Copper, value at New York City....pounds..	812,537,267	105,629,845	901,907,843	139,795,716
Lead, value at New York City....short tons..	307,000	26,402,000	302,000	28,690,000
Zinc, value at New York City....do....	186,702	18,670,200	203,849	24,054,182
Quicksilver, value at San Francisco....flasks..	34,570	1,503,795	30,451	1,103,120
Aluminum, value at Pittsburg....pounds..	8,600,000	2,477,000	11,347,000	3,246,300
Antimony, value, San Francisco...short tons..	3,057	505,524	3,240	705,787
Nickel, value at Philadelphia....pounds..	24,000	11,400	.....	.....
Tin....do....	.....	.....	None.	.....
Platinum, value at New York City, troy ounces....	200	4,160	318	5,320
Total value of metallic products....	.....	502,149,624	.....	702,453,101
NONMETALS (SPOT VALUE).				
Bituminous coal....short tons..	278,659,689	305,397,001	315,062,785	334,658,294
Pennsylvania anthracite....long tons..	65,318,490	138,974,020	69,339,152	141,879,000
Natural gas....	.....	38,496,760	.....	41,562,855
Petroleum....barrels..	117,080,960	101,175,455	134,717,580	84,157,309
Clay products....	.....	131,023,248	.....	149,697,188
Cement....barrels..	31,675,257	26,031,920	40,102,308	35,931,533
Lime....short tons..	2,707,809	9,951,456	2,984,100	10,941,680
Sand-lime brick....	.....	463,128	.....	972,064
Slate....	.....	5,617,195	.....	5,496,207
Stone....	.....	58,765,715	.....	63,798,748
Corundum and emery....short tons..	1,916	56,985	2,126	61,464
Crystalline quartz....do....	31,940	74,850	19,039	88,118
Garnet for abrasive purposes....do....	3,854	117,581	5,050	148,095
Grindstones....	.....	881,527	.....	777,606
Infusorial earth and tripoli....short tons..	6,274	44,164	10,977	64,637
Millstones....	.....	37,338	.....	37,974
Oilstones, etc....	.....	188,985	.....	244,546
Arsenious oxide....pounds..	72,413	2,185	1,507,386	35,210
Borax (crude)....short tons..	45,647	698,810	46,334	1,019,154
Bromine....pounds..	897,100	269,130	1,192,758	178,914
Fluorspar....short tons..	36,452	234,755	57,385	362,488
Gypsum....do....	940,917	2,784,325	1,043,202	3,029,227
Lithium minerals....do....	577	5,155	79	1,412
Marls....do....	18,989	13,145	38,026	16,494
Phosphate rock....long tons..	1,874,428	6,580,875	1,947,190	6,763,403
Pyrite....do....	334,373	3,478,568	253,000	938,492
Sulphur....do....			181,677	3,706,560
Salt....barrels..	22,030,002	6,021,222	25,966,122	6,095,922
Barytes (crude)....short tons..	65,727	174,958	48,235	148,803
Cobalt oxide....pounds..	22,000	42,600	.....	.....
Mineral paints....short tons..	64,592	1,448,551	63,521	1,697,130
Zinc white....do....	63,363	4,808,482	68,603	5,520,240
Asbestos....do....	1,480	25,740	3,109	42,975
Asphalt....do....	108,572	879,836	115,267	758,153
Bauxite....long tons..	47,661	235,704	48,129	240,292
Chromic iron ore....do....	123	1,845	22	375
Feldspar....short tons..	45,188	266,326	35,419	226,157
Fibrous talc....do....	64,005	507,400	56,500	445,000
Fuller's earth....do....	29,480	168,500	25,178	214,497
Glass sand....do....	858,719	796,492	1,060,334	1,107,730
Graphite (crystalline)....pounds..	5,681,177	321,372	6,036,567	318,211
Graphite (amorphous)....short tons..	16,927		21,953	
Magnesite....do....	2,850	9,298	3,933	15,221
Manganese ore....long tons..	3,146	29,466	4,118	36,214
Mica (sheet)....pounds..	668,358	109,462	924,875	160,732
Mica (scrap)....short tons..	1,096	10,854	1,126	17,856
Mineral waters....gallons sold..	41,969,145	6,218,873	46,544,361	6,491,251
Monazite and zircon....pounds..	745,999	85,038	1,352,418	163,908
Precious stones....	.....	324,300	.....	326,350
Pumice stone....short tons..	1,530	5,421	1,832	5,540
Quartz (flint)....do....	52,270	100,590	51,145	104,109
Rutile....pounds..	.....	7,000	.....	.....
Sand, molding, etc., and gravel...short tons..	9,821,009	4,951,607	22,144,633	10,115,915
Talc and soapstone....do....	27,184	433,331	40,134	637,062
Tungsten....do....	740	184,000	803	268,676
Uranium and vanadium....do....	45	10,600	4	375
Total value of nonmetallic mineral products....	.....	859,543,144	.....	921,727,456
Total value of metallic products....	.....	502,149,624	.....	702,453,101
Estimated value of mineral products unspecified....	.....	400,000	.....	400,000
Grand total....	.....	1,362,092,768	.....	1,624,580,557

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Mineral products of the United States for the calendar years 1880–1910—Continued.

Product.	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
METALS.				
Pig iron, spot value.....long tons..	25,307,191	$505,700,000	25,781,361	$529,958,000
Silver, commercial value.....troy ounces..	56,517,900	38,256,400	56,514,700	37,299,700
Gold, coining value.....do....	4,565,333	94,373,800	4,374,827	90,435,700
Copper, value at New York City..pounds..	917,805,662	177,595,888	868,996,491	173,799,300
Lead, value at New York City..short tons..	350,153	39,917,442	365,166	38,707,596
Zinc, value at New York City.....do....	199,694	24,362,668	223,745	26,401,910
Quicksilver, value at San Francisco..flasks..	26,238	958,634	21,567	828,931
Aluminum, value at Pittsburg....pounds..	14,910,000	4,262,286	17,211,039	4,926,948
Antimony, value, San Francisco, short tons.	1,766	602,949	351	77,300
Antimonial lead.....do....	.....	.....	9,910	1,322,985
Nickel, value at Philadelphia.....pounds..	.....	(a)	.....	(a)
Tin.....do....	.....	35,600	.....	33,285
Platinum, value at New York City, troy ounces.....	1,439	45,189	357	10,589
Total value of metallic products.....	.....	886,110,856	.....	903,802,244
NONMETALS (SPOT VALUE).				
Bituminous coal.....short tons..	342,874,867	381,182,115	394,759,112	451,214,842
Pennsylvania anthracite.....long tons..	63,645,010	131,917,694	76,432,421	163,584,056
Natural gas.....	.....	46,873,932	.....	54,222,399
Petroleum.....barrels..	126,493,936	92,444,735	166,095,335	120,106,749
Clay products.....	.....	161,032,722	.....	158,942,360
Cement.....barrels..	51,000,445	55,302,277	52,230,342	55,903,851
Lime.....short tons..	3,198,087	12,480,653	3,092,524	12,656,705
Sand-lime brick.....	.....	1,170,005	.....	1,225,769
Slate.....	.....	5,668,346	.....	6,019,220
Stone.....	.....	66,378,794	.....	71,105,805
Corundum and emery.....short tons..	1,160	44,310	1,009	12,294
Abrasive quartz and feldspar.....do....	24,082	121,671	17,435	126,582
Garnet for abrasive purposes.....do....	4,650	157,000	7,058	211,686
Irindstones.....	.....	744,894	.....	896,022
Infusorial earth and tripoli.....short tons..	8,099	72,108	.....	104,406
Millstones.....	.....	48,590	.....	31,741
Oilstones, etc.....	.....	268,070	.....	264,188
Arsenious oxide.....pounds..	1,474,000	63,460	3,502,000	163,000
Borax (crude).....short tons..	58,173	1,182,410	52,850	1,121,520
Bromine.....pounds..	1,283,250	165,204	1,379,496	195,281
Fluorspar.....short tons..	40,796	244,025	49,486	287,282
Gypsum.....do....	1,540,585	3,837,975	1,751,748	4,942,264
Lithium minerals.....do....	383	7,411	530	11,000
Marls.....do....	19,104	7,341	14,091	8,429
Phosphate rock.....long tons..	2,060,957	8,579,437	2,265,343	10,653,558
Pyrite.....do....	261,422	931,305	247,387	794,949
Sulphur.....do....	294,153	5,096,678	293,106	5,142,850
Salt.....barrels..	28,172,380	6,658,350	29,704,128	7,608,323
Barytes (crude).....short tons..	50,231	160,367	89,621	291,777
Cobalt oxide.....pounds..	.....	(a)	.....	(a)
Mineral paints.....short tons..	69,071	2,165,808	75,566	2,984,935
Zinc oxide.....do....	74,680	5,999,375	71,784	6,490,660
Asbestos.....do....	1,695	28,565	653	11,899
Asphalt.....do....	138,059	1,290,340	223,861	2,826,489
Bauxite.....long tons..	75,332	308,311	97,776	480,330
Chromic iron ore.....do....	107	1,800	290	5,640
Feldspar.....short tons..	75,656	401,531	84,544	499,069
Fibrous talc.....do....	61,672	557,200	67,800	626,000
Fuller's earth.....do....	32,040	265,400	32,851	291,773
Glass sand.....do....	1,089,430	1,208,788	1,187,296	1,250,067
Graphite {crystalline.....pounds..	5,887,982	238,064	4,947,840	171,149
Graphite {amorphous.....short tons..	16,853	102,175	26,803	125,821
Magnesite.....do....	7,805	23,415	7,561	22,683
Manganese ore.....long tons..	6,921	88,132	5,604	63,369
Manganiferous ore.....do....	41,300	122,400	103,844	259,473
Mica {sheet.....pounds..	1,423,100	252,248	1,060,182	349,311
Mica {scrap.....short tons..	1,489	22,742	3,025	42,800
Mineral waters.....gallons sold..	48,108,580	8,028,387	52,060,520	7,331,503
Monazite and zircon.....pounds..	847,275	152,560	548,152	65,800
Precious stones.....	.....	b 589,000	.....	b 735,800
Pumice.....short tons..	12,200	16,750	8,112	33,818
Quartz.....do....	66,607	243,012	22,977	157,094
Rutile.....pounds..	.....	.....	.....	(a)
Sand, molding, etc., and gravel..short tons..	31,842,572	11,489,420	40,664,622	13,242,002
Talc and soapstone.....do....	58,972	874,356	72,010	905,047
Tungsten.....do....	928	348,867	1,640	890,048
Uranium and vanadium.....do....	.....	(a)	.....	(a)
Total value of nonmetallic mineral products.....	.....	1,017,700,525	.....	1,167,711,497
Total value of metallic products.....	.....	886,110,856	.....	903,802,244
Estimated value of mineral products unspecified.....	.....	200,000	.....	100,000
Grand total.....	.....	1,904,011,381	.....	2,071,613,741

a Included under unspecified. b Includes pearls valued at $381,000 in 1906 and at $264,700 in 1907.

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Mineral products of the United States for the calendar years 1880–1910—Continued.

Product.		1908.	
		Quantity.	Value.
METALS.			
Pig iron (spot value)	long tons	15,936,018	$254,221,000
Silver, commercial value	troy ounces	52,440,800	28,050,600
Gold, coining value	do	4,574,340	94,560,000
Copper, value at New York City	pounds	942,570,721	124,419,335
Lead, value at New York City	short tons	310,762	26,104,008
Zinc, value at St. Louis	do	190,749	17,930,406
Quicksilver, value at San Francisco	flasks	19,752	824,146
Aluminum	pounds	11,152,000	2,434,600
Antimony	short tons		
Antimonial lead	do	13,629	1,264,771
Nickel, value at Philadelphia	pounds		(a)
Tin	do		
Platinum, value at New York City	troy ounces	750	14,250
Total value of metals			549,923,116
NONMETALS (SPOT VALUE).			
Bituminous coal	short tons	332,573,944	374,135,268
Pennsylvania anthracite	long tons	74,347,102	158,178,849
Natural gas			54,640,374
Petroleum	barrels	178,527,355	129,079,184
Peat			133,000
Clay products			133,197,762
Cement	barrels	52,910,925	44,477,653
Lime	short tons	2,766,873	11,091,186
Sand (molding, building, etc.), and gravel	do	36,122,491	12,135,433
Sand-lime brick			1,029,699
Slate			6,316,817
Stone			65,712,499
Corundum and emery	short tons	669	8,745
Garnet for abrasive purposes	do	1,996	64,620
Grindstones			536,095
Infusorial earth and tripoli	short tons		97,442
Millstones			31,420
Oilstones, etc			217,284
Pumice	short tons	10,569	39,287
Arsenious oxide	pounds		(a)
Borax (crude)	short tons	25,000	975,000
Bromine	pounds	760,023	73,783
Fluorspar	short tons	38,785	225,998
Gypsum	do	1,721,829	4,075,824
Lithium minerals	do	203	1,550
Marls	do	8,469	4,330
Phosphate rock	long tons	2,386,138	11,399,124
Pyrite	do	222,598	857,113
Sulphur	do	369,444	6,668,215
Salt	barrels	28,822,062	7,553,632
Barytes (crude)	short tons	38,527	120,442
Cobalt oxide	pounds		(a)
Mineral paints	short tons	69,244	2,367,723
Zinc oxide	do	56,292	5,072,460
Asbestos	do	936	19,624
Asphalt	do	198,382	2,057,881
Bauxite	long tons	52,167	263,968
Chromic iron ore	do	359	7,230
Feldspar	short tons	70,474	428,553
Fuller's earth	do	29,714	278,367
Gems and precious stones			415,063
Glass sand	short tons	1,093,553	1,134,599
Graphite (crystalline)	pounds	2,288,000	132,840
Graphite (amorphous)	short tons	1,443	75,250
Magnesite	do	6,587	19,761
Manganese ore	long tons	6,144	62,779
Manganiferous ore	do	55,620	132,556
Mica (sheet)	pounds	972,964	234,021
Mica (scrap)	short tons	2,417	33,904
Mineral waters	gallons sold	55,868,820	6,712,080
Quartz	short tons	47,316	190,157
Talc and soapstone	do	46,615	703,832
Talc, fibrous	do	70,739	697,390
Thorium minerals (monazite), and zircon	pounds	422,646	50,718
Titanium ore (rutile)	do		
Tungsten ore	short tons	671	229,955
Uranium and vanadium minerals	do		
Total value of nonmetals			1,044,398,939
Total value of metals			549,923,116
Estimated value of mineral products unspecified [a]			250,000
Grand total			1,594,572,055

[a] Included under unspecified.

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Mineral products of the United States for the calendar years 1880–1910—Continued.

Product.		1909.	
		Quantity.	Value.
METALS.			
Pig iron (spot value)	long tons	25,795,471	$419,175,000
Silver, commercial value	troy ounces	54,721,500	28,455,200
Gold, coining value	do	4,821,701	99,673,400
Copper, value at New York City	pounds	1,092,951,624	142,083,711
Lead, value at New York City	short tons	354,188	30,460,168
Zinc, value at St. Louis	do	230,225	24,864,300
Quicksilver, value at San Francisco	flasks	21,075	957,859
Aluminum	pounds	34,210,000	6,575,000
Antimony	short tons		
Antimonial lead	do	12,896	1,231,019
Nickel, value at Philadelphia	pounds		(a)
Tin	do		4,832
Platinum, value at New York City	troy ounces	638	15,950
Total value of metals			753,496,439
NONMETALS (SPOT VALUE).			
Bituminous coal	short tons	379,744,257	405,496,777
Pennsylvania anthracite	long tons	72,384,249	149,181,587
Natural gas			63,206,941
Petroleum	barrels	183,170,874	128,328,487
Peat			127,042
Clay products			166,321,213
Cement	barrels	66,689,715	53,610,563
Lime	short tons	3,484,974	13,846,072
Sand (molding, building, etc.) and gravel	do	58,461,100	17,173,615
Sand-lime brick			1,150,580
Slate			5,441,418
Stone			71,345,199
Corundum and emery	short tons	1,580	18,185
Garnet for abrasive purposes	do	2,972	102,315
Grindstones			804,051
Infusorial earth and tripoli	short tons		122,348
Millstones			35,393
Oilstones, etc			214,019
Pumice	short tons	15,103	33,439
Arsenious oxide	pounds	2,428,000	52,946
Borax (crude)	short tons	41,434	1,534,365
Bromine	pounds	569,725	57,600
Fluorspar	short tons	50,742	291,747
Gypsum	do	2,252,785	5,906,738
Lithium minerals	do		(a)
Phosphate rock	long tons	2,330,152	10,772,120
Pyrite	do	247,070	1,028,157
Sulphur	do	239,312	4,432,066
Salt	barrels	30,107,646	8,343,831
Barytes (crude)	short tons	61,945	209,737
Cobalt oxide	pounds		(a)
Mineral paints	short tons	78,771	2,373,805
Zinc oxide	do	68,974	6,156,755
Asbestos	do	3,085	62,603
Asphalt	do	228,655	2,138,273
Bauxite	long tons	129,101	679,447
Chromic iron ore	do	598	8,300
Feldspar	short tons	76,539	424,602
Fuller's earth	do	33,486	301,604
Gems and precious stones			534,380
Glass sand	short tons	1,104,451	1,163,375
Graphite (crystalline)	pounds	6,294,400	313,271
Graphite (amorphous)	short tons	5,096	32,238
Magnesite	do	9,465	37,860
Manganese ore	long tons	1,544	19,675
Manganiferous ore	do	68,654	215,925
Mica (sheet)	pounds	1,809,582	234,482
Mica (scrap)	short tons	4,090	46,047
Mineral waters	gallons sold	64,674,486	6,894,134
Quartz	short tons	135,469	249,466
Talc and soapstone	do	81,802	862,002
Talc, fibrous	do	48,536	359,957
Thorium minerals (monazite) and zircon	pounds	543,931	65,282
Titanium ore (rutile)	do		10,000
Tungsten ore	short tons	1,619	614,370
Uranium and vanadium minerals	do		(a)
Total value of nonmetals			1,132,976,404
Total value of metals			753,496,439
Estimated value of mineral products unspecified [a]			300,000
Grand total			1,886,772,843

[a] Included under unspecified.

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Mineral products of the United States for the calendar years 1880–1910—Continued.

Product.	1910.	
	Quantity.	Value.
METALS.		
Pig iron (spot value)..long tons..	27,303,567	$426,115,235
Silver, commercial value..troy ounces..	57,137,900	30,854,500
Gold, coining value..do..	4,657,018	96,269,100
Copper, value at New York City..pounds..	1,080,159,509	137,180,257
Lead, value at New York City..short tons..	372,227	32,755,976
Zinc, value at St. Louis..do..	252,479	27,267,732
Quicksilver, value at San Francisco..flasks..	20,601	968,153
Aluminum..pounds..	47,734,000	8,955,700
Antimonial lead..short tons..	14,069	1,338,055
Tin..pounds..	.....	23,447
Platinum, value at New York City..troy ounces..	773	25,277
Total value of metals..	.....	760,743,467
NONMETALS (SPOT VALUE).		
Bituminous coal..short tons..	417,111,142	469,281,719
Pennsylvania anthracite..long tons..	75,433,246	160,275,302
Natural gas..	.....	70,756,158
Petroleum..barrels..	209,556,048	127,896,328
Peat..	.....	140,209
Clay products..	.....	170,115,974
Cement..barrels..	77,785,141	68,752,092
Lime..short tons..	3,481,780	13,894,962
Sand (molding, building, etc.) and gravel..do..	66,949,347	19,520,919
Sand-lime brick..	.....	1,169,153
Slate..	.....	6,236,759
Stone..	.....	76,520,584
Corundum and emery..short tons..	1,028	15,077
Garnet for abrasive purposes..do..	3,814	113,574
Grindstones..	.....	796,294
Infusorial earth and tripoli..short tons..	.....	130,006
Millstones..	.....	28,217
Oilstones, etc..	.....	228,694
Pumice..short tons..	23,271	94,943
Arsenious oxide..pounds..	2,994,000	52,305
Borax (crude)..short tons..	42,357	1,201,842
Bromine..pounds..	245,437	41,684
Fluorspar..short tons..	69,427	430,196
Gypsum..do..	2,379,057	6,523,029
Lithium minerals..do..	.....	(a)
Phosphate rock..long tons..	2,654,988	10,917,000
Pyrite..do..	238,154	958,608
Sulphur..do..	255,534	4,605,112
Salt..barrels..	30,305,656	7,900,344
Barytes (crude)..short tons..	42,975	121,746
Mineral paints..do..	85,685	2,174,735
Zinc oxide..do..	59,333	5,325,636
Asbestos..do..	3,693	68,357
Asphalt..do..	260,080	3,080,067
Bauxite..long tons..	148,932	716,258
Chromic iron ore..do..	205	2,729
Feldspar..short tons..	81,102	502,452
Fuller's earth..do..	32,822	293,709
Gems and precious stones..	.....	295,797
Glass sand..short tons..	1,461,089	1,516,711
Graphite (crystalline)..pounds..	5,590,592	295,733
Graphite (amorphous)..short tons..	35,945	81,443
Magnesite..do..	12,443	74,658
Manganese ore..long tons..	2,258	22,892
Manganiferous ore..do..	61,101	186,765
Mica (sheet)..pounds..	2,476,190	283,832
Mica (scrap)..short tons..	4,065	53,265
Mineral waters..gallons sold..	62,030,125	6,357,590
Quartz..short tons..	63,577	193,757
Talc and soapstone..do..	79,006	864,213
Talc, fibrous..do..	71,710	728,180
Thorium minerals (monazite) and zircon..pounds..	99,301	12,006
Titanium ore (rutile)..do..	566	44,480
Tungsten ore..short tons..	1,821	807,307
Uranium and vanadium minerals..do..	.....	(a)
Total value of nonmetals..	.....	1,242,701,402
Total value of metals..	.....	760,743,467
Estimated value of mineral products unspecified..	.....	300,000
Grand total..	.....	2,003,744,869

a Included under unspecified.

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OUTPUT AND VALUE, BY STATES AND TERRITORIES, OF THE MINERAL PRODUCTS OF THE UNITED STATES IN THE CALENDAR YEARS 1909 AND 1910.

In the following table are shown the quantity and the value, by States and Territories, of the mineral products of the United States in 1909 and 1910.

The values for gold and silver are the official figures agreed upon by the United States Geological Survey and the Director of the Mint. The figures for the tonnage (not the value) of pig iron in 1909 and 1910 are taken from the annual reports prepared by Mr. James M. Swank, general manager of the American Iron and Steel Association.[1]

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910.

ALABAMA.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$1,700,127		$1,667,559
Coal, short tons	13,703,450	16,306,236	16,111,462	20,236,858
Gold, fine ounces (troy)	1,413	29,200	1,592	32,900
Graphite, short tons		(a)		(a)
Iron, pig, long tons	1,763,617	22,222,000	1,939,147	23,754,551
Lime, short tons	75,268	290,059	81,696	303,612
Mica		(a)		
Mineral waters, gallons sold	116,645	28,595	133,159	30,639
Natural gas		(a)		(a)
Sand and gravel, short tons	611,778	214,396	619,253	187,591
Silver, fine ounces (troy)	200	100	300	200
Stone		(a)		(a)
Other products		a 1,191,495		a 1,537,204
Total		41,982,208		47,751,109

ALASKA.

Coal, short tons	2,800	$12,300	1,000	$15,000
Copper, pounds	4,057,142	527,428	4,311,026	547,500
Gold, fine ounces (troy)	983,928	20,339,600	787,148	16,271,800
Lead, short tons	60	5,160	60	5,280
Silver, fine ounces (troy)	198,600	103,300	153,900	83,100
Stone		(b)		(b)
Other products		b 207,130		b 269,008
Total		21,194,918		17,191,688

ARIZONA.

Clay products		$107,940		$126,777
Copper, pounds	291,110,298	37,844,339	297,250,538	37,750,818
Gold, fine ounces (troy)	127,071	2,626,800	165,114	3,413,200
Lead, short tons	1,465	125,990	858	75,504
Lime, do	12,473	84,223	13,728	68,055
Gems and precious stones		46,667		32,510
Silver, fine ounces (troy)	2,523,600	1,312,300	2,655,700	1,434,100
Stone		(c)		(c)
Tungsten ore		(c)		(c)
Zinc, short tons	2,862	309,096	2,594	280,152
Other products		c 698,111		c 302,796
Total		43,155,466		43,483,912

a Includes in 1909: Bauxite, Portland and puzzolan cement, fuller's earth, graphite, mica, millstones, natural gas, pyrite, stone; in 1910: Bauxite, Portland and puzzolan cement, graphite, millstones, natural gas, stone.

b Includes in 1909: Graphite, gypsum, stone; in 1910: Graphite, gypsum, stone, tin.

c Includes in 1909: Portland cement, fluorspar, gypsum, quartz, sand and gravel, stone, tungsten ore; in 1910: Portland cement, gypsum, quartz, sand and gravel, stone, tungsten ore.

[1] Ann. Statist. Rept. Am. Iron and Steel Association for the years 1909 and 1910.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

ARKANSAS.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Clay products		.....	$627,024	.....	$578,455
Coal	short tons	2,377,157	3,523,139	1,906,968	2,979,213
Fuller's earth	do	2,314	18,313	2,563	29,137
Gems and precious stones		.....	2,033	.....	1,200
Glass sand	short tons	.....	(a)	.....	.....
Lead	do	14	1,204	.....	.....
Lime	do	28,065	133,025	26,532	127,068
Manganiferous ore	long tons	.....	(a)	5,030	9,700
Mineral waters	gallons sold	1,213,742	153,163	1,065,676	89,772
Natural gas		.....	(a)	.....	(a)
Oilstones		.....	72,334	.....	(a)
Sand and gravel	short tons	1,084,805	249,734	1,061,037	230,680
Stone		.....	330,603	.....	382,611
Zinc	short tons	135	14,580	286	30,888
Other products		.....	a 764,177	.....	a 891,981
Total		.....	5,889,329	.....	5,350,705

CALIFORNIA.

Asphalt	short tons	127,115	$926,848	143,496	$1,338,736
Borax	do	41,434	1,534,365	42,357	1,201,842
Cement, Portland	barrels	3,936,581	5,899,784	5,805,098	7,855,301
Chromite	long tons	.....	(b)	205	2,729
Clay products		.....	4,437,165	.....	4,842,391
Coal	short tons	45,836	95,042	11,164	18,336
Copper	pounds	53,568,708	6,963,932	45,760,200	5,811,545
Gems and precious stones		.....	239,690	.....	104,648
Glass sand	short tons	.....	(b)	.....	(b)
Gold	fine ounces (troy)	1,001,537	20,703,600	988,853	20,441,400
Gypsum		.....	(b)	.....	242,203
Lead	short tons	937	80,582	1,160	102,080
Lime	do	62,942	528,373	63,759	613,242
Magnesite	do	9,465	37,860	.....	74,658
Manganese ore	long tons	.....	(b)	.....	.....
Mineral waters	gallons sold	2,179,187	444,230	2,008,697	394,841
Natural gas		.....	446,933	.....	476,697
Ocher	short tons	.....	(b)	118	1,730
Petroleum	barrels	55,471,601	30,756,713	73,010,560	35,749,473
Platinum	fine ounces (troy)	316	7,900	.....	.....
Pyrite	long tons	51,266	254,235	23,700	110,134
Quicksilver	flasks	16,078	730,745	17,211	800,484
Salt	barrels	886,564	558,889	937,514	519,667
Sand and gravel	short tons	1,206,557	313,774	.....	(b)
Sand-lime brick		.....	30,056	.....	43,512
Silver	fine ounces (troy)	2,304,900	1,198,500	1,791,600	967,500
Slate		.....	(b)	.....	(b)
Stone		.....	3,444,900	.....	(b)
Other products		.....	b 464,465	.....	b 4,955,198
Total		.....	80,098,581	.....	86,668,347

a Includes in 1909: Bauxite, glass sand, manganiferous ore, natural gas, phosphate rock, sand-lime brick; in 1910: Bauxite, manganese ore, natural gas, oilstones.

b Includes in 1909: Chromite, fuller's earth, feldspar, glass sand, gypsum, infusorial earth, manganese ore, metallic paint, ocher, slate, talc, tungsten ore; in 1910: Feldspar, fuller's earth, glass sand, infusorial earth, metallic paint, pig iron, sand and gravel, slate, stone, talc, tungsten ore.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

COLORADO.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Clay products			$2,049,024		$2,083,714
Coal	short tons	10,716,936	14,296,012	11,973,736	17,026,934
Copper	pounds	11,485,631	1,493,132	9,307,497	1,182,052
Fluorspar	short tons	350	2,100		(a)
Gems and precious stones			4,371		9,280
Gold	fine ounces (troy)	1,056,829	21,846,600	992,969	20,526,500
Gypsum	short tons				118,809
Lead	do	29,326	2,522,036	35,685	3,140,280
Lime	do	5,024	26,935	8,057	40,860
Manganiferous ore	long tons	65,024	209,495	55,770	176,448
Mica			(a)		(a)
Mineral waters	gallons sold	1,077,820	111,158	1,638,964	115,289
Natural gas			(a)		(a)
Petroleum	barrels	310,861	318,162	239,794	243,402
Sand and gravel	short tons	402,693	95,381	1,197,751	154,039
Silver	fine ounces (troy)	8,846,300	4,600,100	8,523,000	4,602,400
Stone			(a)		(a)
Tungsten ore			391,160		535,567
Vanadium mineral			(a)		(a)
Zinc	short tons	20,121	2,173,068	23,238	2,509,704
Other products			a 9,051,690		a 7,942,437
Total			59,190,424		60,357,715

CONNECTICUT.

Feldspar	short tons	13,644	$65,827	18,739	$89,974
Gems and precious stones			350		
Lime	short tons	83,096	405,545	93,576	417,850
Mineral waters	gallons sold	691,296	42,375	1,602,775	109,803
Quartz	short tons	9,583	51,521		(b)
Sand and gravel	do	15,759	12,482	16,676	12,775
Stone			(b)		(b)
Other products			b 2,902,818		b 2,874,709
Total			3,480,918		3,505,161

DELAWARE.

Clay products			$231,505		$216,555
Sand and gravel	short tons	150,793	78,923	164,066	66,809
Stone			456,328		357,708
Other products			c 109,745		c 22,941
Total			876,501		664,073

DISTRICT OF COLUMBIA.

Clay products			$214,489		$242,861
Other products			29,580		46,088
Total			244,069		288,949

a Includes in 1909: Portland cement, fuller's earth, graphite, grindstones, gypsum, mica, natural gas, pig iron, sand-lime brick, stone, vanadium mineral, zinc-lead; in 1910: Portland cement, fluorspar, fuller's earth, graphite, grindstones, mica, natural gas, pig iron, sand-lime brick, stone.

b Includes in 1909: Clay products, infusorial earth, metallic paint, pig iron, stone; in 1910: Clay products, infusorial earth, pig iron, quartz, stone.

c Includes in 1909: Mineral waters, sand-lime brick, etc.; in 1910: Mineral waters, sand-lime brick, etc.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

FLORIDA.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$298,620		$237,268
Fuller's earth, short tons	22,218	203,236	18,832	170,267
Lime, do	11,558	50,569	10,482	58,386
Mineral waters, gallons sold	113,944	16,534	90,189	14,269
Phosphate rock, long tons	1,779,702	8,541,301	2,067,507	8,647,774
Sand and gravel, short tons	43,566	28,611	34,858	21,912
Sand-lime brick		77,076		85,450
Stone				(a)
Other products		23,544		a 49,379
Total		9,239,491		9,284,705

GEORGIA.

Clay products		$2,294,501		$2,532,038
Coal, short tons	211,196	298,792	177,245	259,122
Copper, pounds			724	92
Glass sand, short tons		(b)		(b)
Gold, fine ounces (troy)	2,099	43,400	1,161	24,000
Lime, short tons	11,903	44,962	7,621	29,961
Mineral waters, gallons sold	782,166	99,888	734,135	63,171
Ocher, short tons	5,838	60,971	7,011	70,388
Sand and gravel, do	434,276	206,263		(b)
Sand-lime brick		(b)		(b)
Silver, fine ounces (troy)	200	100	300	200
Stone		1,644,584		2,027,339
Talc and soapstone, short tons		(b)		(b)
Other products		b 887,182		b 1,041,942
Total		5,580,643		6,048,253

IDAHO.

Coal, short tons	4,553	$19,459	4,448	$17,426
Copper, pounds	7,096,132	922,497	6,877,515	873,444
Gold, fine ounces (troy)	65,026	1,344,200	50,112	1,035,900
Lead, short tons	97,183	8,357,738	99,924	8,793,312
Lime, do	12,631	81,463	8,094	48,298
Salt, barrels	793	1,118	885	1,127
Silver, fine ounces (troy)	6,755,900	3,513,100	7,027,000	3,794,600
Stone		68,315		(c)
Zinc, short tons	901	97,308	3,454	373,032
Other products		c 503,621		c 500,264
Total		14,908,819		15,437,403

ILLINOIS.

Cement:				
Natural, barrels		(d)		(d)
Portland, do	4,241,392	$3,388,667	4,459,450	$4,119,012
Clay products		14,344,453		15,176,161
Coal, short tons	50,904,990	53,522,014	45,900,246	52,405,897
Fluorspar, do	41,852	232,251	47,302	277,764
Glass sand, do	224,381	153,226	268,654	216,531
Infusorial earth		39,262		33,390
Iron, pig, long tons	2,467,156	44,211,000	2,675,646	42,917,362
Lead, short tons	273	23,478	262	23,056
Lime, do	104,260	454,682	113,239	503,581

a Includes in 1910: Stone, etc.

b Includes in 1909: Asbestos, barytes, bauxite, Portland and natural cement, fuller's earth, glass sand, graphite, infusorial earth, mica, pig iron, pyrite, sand and gravel, sand-lime brick, slate, talc and soapstone, in 1910: Asbestos, barytes, bauxite, Portland and natural cement, fuller's earth, glass sand, graphite; metallic paint, pig iron, pyrite, sand and gravel, sand-lime brick, slate, talc.

c Includes in 1909: Asbestos, clay products, mineral waters, phosphate rock, pumice, sand and gravel, sand-lime brick, tungsten ore; in 1910: Asbestos, clay products, mineral waters, phosphate rock, sand and gravel, sand-lime brick, stone.

d Includes in 1909: Natural cement, etc.; in 1910: Natural cement, sand and gravel, sublimed blue and white lead, leaded zinc, zinc oxide.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

ILLINOIS—Continued.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Mineral waters	gallons sold	630,460	49,108	1,117,620	83,148
Natural gas		.....	644,401	.....	613,642
Petroleum	barrels	30,896,339	19,788,864	33,143,362	19,669,383
Pyrite	long tons	5,600	17,551	8,541	28,159
Sand and gravel	short tons	8,930,848	1,796,271	.....	(a)
Silver	fine ounces (troy)	900	500	2,000	1,100
Stone		.....	4,261,818	.....	3,853,425
Zinc	short tons	675	72,900	351	167,508
Other products		.....	a 51,283	.....	a 1,720,002
Total		.....	143,051,729	.....	141,809,121

INDIANA.

Cement:					
Natural	barrels	177,924	$52,647	.....	(b)
Portland	do	7,026,081	5,331,468	7,219,199	$6,487,508
Clay products		.....	7,645,223	.....	8,100,010
Coal	short tons	14,834,259	15,154,681	18,389,815	20,813,659
Glass sand	do	.....	(b)	.....	(b)
Lime	do	99,325	335,154	86,811	301,304
Mineral waters	gallons sold	663,815	446,249	754,111	514,958
Natural gas		.....	1,616,903	.....	1,473,403
Oilstones		.....	7,095	.....	(b)
Petroleum	barrels	2,296,086	1,997,610	2,159,725	1,568,475
Sand and gravel	short tons	4,436,986	802,832	.....	.....
Sand-lime brick		.....	32,800	.....	63,534
Stone		.....	3,753,358	.....	4,476,382
Other products		.....	b 6,368,595	.....	b 15,240,070
Total		.....	43,634,615	.....	59,039,308

IOWA.

Clay products		.....	$4,898,696	.....	$5,328,241
Coal	short tons	7,757,762	12,793,628	7,928,120	13,903,913
Gypsum	do	.....	655,602	.....	943,849
Lead	do	15	1,290	.....	.....
Lime	do	15,739	82,202	15,481	81,775
Mineral waters	gallons sold	184,000	14,116	253,100	27,175
Sand and gravel	short tons	1,530,904	458,829	1,798,762	464,427
Sand-lime brick		.....	48,210	.....	31,269
Stone		.....	527,720	.....	558,056
Zinc	short tons	.....	.....	40	4,320
Other products		.....	c 862,075	.....	c 1,387,943
Total		.....	20,342,368	.....	22,730,968

KANSAS.

Cement, Portland	barrels	5,334,299	$3,792,764	5,655,808	$5,359,408
Clay products		.....	2,709,822	.....	2,661,527
Coal	short tons	6,986,478	10,083,384	4,921,451	7,914,709
Gypsum	do	.....	318,678	.....	370,695
Lead	do	2,764	237,704	1,308	115,104
Lime	do	1,332	8,018	1,510	7,503
Mineral waters	gallons sold	633,024	89,796	591,004	82,307
Natural gas		.....	8,293,846	.....	7,755,367
Petroleum	barrels	1,263,764	491,633	1,128,668	444,763
Salt	do	2,709,849	782,676	2,811,448	947,369
Sand and gravel	short tons	977,918	188,708	776,638	165,659
Stone		.....	911,895	.....	794,430
Zinc	short tons	9,185	991,980	10,220	1,103,760
Other products		.....	d 546,255	.....	d 581,590
Total		.....	29,447,159	.....	28,304,191

a Includes in 1909: Natural cement, etc.; in 1910: Natural cement, sand and gravel, sublimed blue and white lead, leaded zinc, zinc oxids.

b Includes in 1909: Glass sand, pig iron, pyrite; in 1910: Natural cement, gems and precious stones, glass sand, oilstones, pig iron, pyrite, sand and gravel.

c Includes in 1909: Portland cement, natural gas, ocher, slate and shale; in 1910: Portland cement, natural gas, ocher, slate and shale.

d Includes in 1909: Natural cement, pottery, sand-lime brick, zinc-lead, zinc oxide; in 1910: Natural cement, pottery, pumice, sand-lime brick, leaded zinc, zinc oxide.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

KENTUCKY.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	15,898	$85,005	11,225	$65,929
Barytes.....do....	.....	(a)	.....	(a)
Clay products.....	.....	2,478,872	.....	2,567,537
Coal.....short tons..	10,607,384	10,079,917	14,623,319	14,405,887
Fluorspar.....do....	7,800	53,233	17,003	124,574
Glass sand.....do....	.....	(a)	.....	(a)
Lead.....do....	.....	.....	50	4,400
Lime.....do....	4,331	13,741	3,622	12,468
Mineral waters.....gallons sold..	756,425	73,767	403,736	55,195
Natural gas.....	.....	485,192	.....	456,293
Petroleum.....barrels..	639,016	518,299	468,774	324,684
Sand and gravel.....short tons..	760,857	429,568	.....	(a)
Stone.....	.....	(a)	.....	(a)
Zinc.....short tons..	22	2,376	29	3,132
Other products.....	.....	a 2,637,178	.....	a 3,492,883
Total.....	.....	16,857,148	.....	21,512,982

LOUISIANA.

Clay products.....	.....	$528,261	.....	$546,873
Mineral waters.....gallons sold..	1,375,000	103,850	2,313,000	163,975
Natural gas.....	.....	(b)	.....	(b)
Petroleum.....barrels..	3,059,531	2,022,449	6,841,395	3,574,069
Salt.....do....	.....	(c)	(c)	(c)
Sand and gravel.....short tons..	651,144	302,618	835,295	372,336
Other products.....	.....	b 4,701,263	.....	b 5,462,740
Total.....	.....	7,658,441	.....	10,119,993

MAINE.

Clay products.....	.....	$635,667	.....	$599,881
Feldspar.....short tons..	18,137	166,031	20,762	196,463
Gems and precious stones.....	.....	15,086	.....	3,305
Lime.....short tons..	178,564	957,690	179,656	893,599
Mineral waters.....gallons sold..	1,515,541	402,593	1,238,171	404,539
Slate.....	.....	227,882	.....	249,005
Stone.....	.....	(d)	.....	(d)
Other products.....	.....	d 1,971,539	.....	d 2,366,331
Total.....	.....	4,376,488	.....	4,713,123

MARYLAND.

Clay products.....	.....	$1,720,812	.....	$1,848,273
Coal.....short tons..	4,023,241	4,471,731	5,217,125	5,835,058
Feldspar.....do....	6,564	35,399	9,977	47,340
Glass sand.....do....	.....	(e)	.....	(e)
Iron, pig.....long tons..	286,856	4,673,000	326,214	5,230,824
Lime.....short tons..	125,436	367,945	121,555	377,236
Mineral waters.....gallons sold..	938,496	91,569	1,163,828	102,371
Sand and gravel.....short tons..	446,679	183,393	.....	(e)
Slate.....	.....	129,538	.....	78,573
Stone.....	.....	(e)	.....	(e)
Talc and soapstone.....short tons..	.....	(e)	.....	(e)
Other products.....	.....	e 1,208,187	.....	e 1,920,532
Total.....	.....	12,881,574	.....	15,440,207

a Includes in 1909: Barytes, Portland and natural cement, glass sand, oilstones, pig iron, sand-lime brick, stone; in 1910: Barytes, natural and Portland cement, glass sand, ocher, pig iron, sand and gravel, sand-lime brick, silver, stone.

b Includes in 1909: Natural gas, pottery, stone, sulphur; in 1910: Natural gas, pottery, salt, stone, sulphur.

c Included under New York.

d Includes in 1909: Mica, pottery, sand and gravel, stone; in 1910: Pottery, sand and gravel, stone.

e Includes on 1909: Portland cement, glass sand, metallic paint and mortar colors, quartz, sand-lime brick, stone, talc and soapstone, umber; in 1910: Portland cement, glass sand, infusorial earth, metallic paint, mortar colors, quartz, sand and gravel, sand-lime brick, stone, talc.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

MASSACHUSETTS.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Clay products			$1,887,886		$1,707,413
Gems and precious stones			250		280
Glass sand	short tons		(a)		(a)
Lime	do	136,546	709,128	140,942	758,739
Mineral waters	gallons sold	5,424,062	228,067	4,691,159	241,949
Sand and gravel	short tons	328,309	191,013		(a)
Stone			(a)		(a)
Talc and soapstone	short tons	9,057	48,729	7,475	52,204
Other products			a 3,714,901		a 3,316,785
Total			6,779,974		6,077,370

MICHIGAN.

Cement, Portland	barrels	3,212,751	$2,619,259	3,687,719	$3,378,940
Clay products			2,042,498		2,196,222
Coal	short tons	1,784,692	3,199,351	1,534,967	2,930,771
Copper	pounds	227,005,923	29,510,770	221,462,984	28,125,792
Gems and precious stones			2,700		2,500
Glass sand	short tons	65,000	79,000		(b)
Gypsum			1,213,347		668,201
Lime	short tons	83,108	354,135	72,345	303,377
Mineral waters	gallons sold	2,760,604	104,454	1,454,020	69,538
Salt	barrels	9,966,744	2,732,556	9,452,022	2,231,262
Sand and gravel	short tons	2,154,757	606,632		(b)
Sand-lime brick			218,226		240,649
Silver	fine ounces (troy)	217,600	113,100	262,200	141,600
Stone			(b)		(b)
Other products			b 12,245,643		b 7,482,916
Total			55,041,671		47,771,775

MINNESOTA.

Clay products			$1,755,438		$1,901,296
Gems and precious stones			100		160
Lime	short tons	43,841	215,568	21,020	96,150
Mineral waters	gallons sold	13,746,142	614,291	9,962,370	281,009
Sand and gravel	short tons	1,339,039	332,162	1,938,112	347,138
Sand-lime brick			113,069		154,250
Stone			(c)		(c)
Other products			c 2,657,492		c 3,308,617
Total			5,688,120		6,088,620

MISSISSIPPI.

Clay products			$798,350		$632,999
Mineral waters	gallons sold	307,315	52,925	309,450	43,975
Sand and gravel	short tons	517,338	269,364	363,121	159,482
Other products			9,000		3,696
Total			1,129,639		840,152

a Includes in 1909: Portland cement, feldspar, fuller's earth, glass sand, graphite, infusorial earth, pig iron, pyrite, quartz, stone; in 1910: Feldspar, fuller's earth, glass sand, infusorial earth, mica, pig iron, pyrite, quartz, sand and gravel, stone.

b Includes in 1909: Bromine, graphite, grindstones, metallic paint, natural gas, oilstones, petroleum, pig iron, quartz, stone; in 1910: Bromine, glass sand, graphite, grindstones, metallic paint, natural gas, oilstones, pig iron, petroleum, quartz, sand and gravel, stone.

c Includes in 1909: Natural cement, pig iron, pottery, stone: in 1910: Natural cement, feldspar, pig iron, pottery, stone.

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Output and value, by States and Territories, of the mineral products of the United States in the calenaar years 1909 and 1910—Continued.

MISSOURI.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	34,815	$119,818	22,978	$75,598
Cement, Portland.....barrels..	3,445,076	2,808,916	4,455,589	3,858,088
Clay products.....	.....	7,440,183	.....	7,087,766
Coal.....short tons..	3,756,530	6,183,626	2,982,433	5,328,285
Copper.....pounds..	.....	(a)	.....	(a)
Glass sand.....short tons..	98,480	73,082	186,342	130,686
Gold.....fine ounces (troy)..	10	200	.....	.....
Infusorial earth.....	.....	66,557	.....	71,978
Lead.....short tons..	142,650	12,267,900	161,659	14,225,992
Lime.....do....	182,460	815,367	179,550	846,123
Mineral waters.....gallons sold..	765,032	111,448	657,035	96,488
Natural gas.....	.....	10,025	.....	12,611
Sand and gravel.....short tons..	4,229,772	928,249	5,922,118	1,208,833
Silver.....fine ounces (troy)..	15,200	7,900	32,200	17,400
Stone.....	.....	2,295,763	.....	2,520,665
Sublimed blue, Sublimed white} lead.....short tons..	.....	(a)	.....	(a)
Zinc.....do....	140,676	15,193,008	140,652	15,190,416
Other products.....	.....	a 2,094,001	.....	a 1,969,125
Total.....	.....	50,416,043	.....	52,640,054

MONTANA.

Clay products.....	.....	$451,389	.....	$411,824
Coal.....short tons..	2,553,940	5,036,942	2,920,970	5,329,322
Copper.....pounds..	314,858,291	40,931,578	283,078,473	35,950,066
Gems and precious stones.....	.....	44,908	.....	57,923
Gold.....fine ounces (troy)..	181,411	3,750,100	179,975	3,720,400
Lead.....short tons..	1,376	118,336	1,790	157,520
Lime.....do....	4,540	27,713	4,480	26,925
Silver.....fine ounces (troy)..	12,034,500	6,257,900	12,282,900	6,632,700
Stone.....	.....	(b)	.....	(b)
Zinc.....short tons..	4,725	510,300	12,408	1,340,064
Other products.....	.....	b 363,550	.....	b 760,473
Total.....	.....	57,492,806	.....	54,388,117

NEBRASKA.

Clay products.....	.....	$1,146,449	.....	$938,827
Mineral waters.....gallons sold..	.....	(c)	12,785	1,529
Sand and gravel.....short tons..	786,608	119,902	1,076,602	168,255
Stone.....	.....	293,830	.....	338,731
Other products.....	.....	c 39,637	.....	c105,452
Total.....	.....	1,599,818	.....	1,552,794

NEVADA.

Copper.....pounds..	53,849,281	$7,000,407	64,494,640	$8,190,819
Gems and precious stones.....	.....	120,518	.....	49,210
Gold.....fine ounces (troy)..	792,682	16,386,200	913,015	18,873,700
Lead.....short tons..	4,698	404,028	2,195	193,160
Salt.....barrels..	16,107	19,847	17,535	10,600
Silver.....fine ounces (troy)..	10,119,200	5,262,000	12,366,000	6,677,600
Zinc.....short tons..	825	89,100	1,516	163,728
Other products.....	.....	a 346,727	.....	d 458,310
Total.....	.....	29,628,826	.....	34,617,127

a Includes in 1909: Cobalt oxide, copper, nickel, petroleum, pig iron, sublimed blue lead, sublimed white lead; in 1910: Copper, metallic paints, petroleum, pig iron, sublimed blue and white lead.
b Includes in 1909: Arsenic, gypsum, mineral waters, pottery, sand and gravel, sand-lime brick, stone; in 1910: Portland cement, gypsum, mineral waters, pottery, sand and gravel, sand-lime brick, stone.
c Includes in 1909: Mineral waters, pumice, sand-lime brick; in 1910: Pumice, sand-lime brick, etc.
d Includes in 1909: Clay products, graphite, gypsum, lime, quicksilver, sand and gravel, stone, sulphur; in 1910: Clay products, graphite, gypsum, mineral waters, quicksilver, stone, sulphur.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

NEW HAMPSHIRE.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$552,215		$566,126
Copper, pounds		(a)	12,409	1,576
Gold, fine ounces (troy)			285	5,900
Mica		16,180		(a)
Mineral waters, gallons sold	934,072	245,607	706,828	202,831
Silver, fine ounces (troy)	3,000	1,600	700	400
Stone		1,215,461		1,239,656
Other products		a 125,922		a 130,252
Total		2,156,985		2,146,736

NEW JERSEY.

Cement, Portland, barrels	4,046,322	$2,813,162	4,184,698	$3,067,265
Clay products		17,172,094		17,834,309
Gems and precious stones		335		500
Glass sand, short tons	85,696	62,830	87,680	61,078
Iron, pig, long tons	294,474	4,473,000	264,781	4,204,722
Lime, short tons	38,014	146,401	34,148	128,964
Mineral waters, gallons sold	1,419,500	127,025	1,583,050	133,139
Sand and gravel, short tons	2,605,018	872,543	2,875,135	1,078,197
Sand-lime brick		21,925		23,811
Slate		(b)		(b)
Stone		1,613,861		1,675,174
Zinc, short tons	16,035	1,731,780	20,217	2,183,436
Other products		b 591,373		b 498,297
Total		29,626,329		30,888,892

NEW MEXICO.

Clay products		$182 755		$129,275
Coal, short tons	2,801,128	3,619,744	3,508,321	4,877,151
Copper, pounds	5,031,136	654,048	3,784,609	480,645
Gems and precious stones		25,636		16,800
Gold, fine ounces (troy)	12,229	252,800	23,085	477,200
Lead, short tons	1,275	109,650	1,731	152,328
Lime, do	2,640	14,200	4,445	17,930
Mineral water, gallons sold	157,700	28,839	171,600	30,160
Sand and gravel, short tons	4,902	3,032	4,310	2,043
Silver, fine ounces (troy)	324,200	168,600	779,000	420,600
Stone		300,313		443,650
Zinc, short tons	3,961	427,788	4,911	530,388
Other products		c 83,142		c 126,203
Total		5,870,547		7,704,373

a Includes in 1909: Copper, lead, pottery, whetstones; in 1910: Mica, oilstones, pottery.
b Includes in 1909: Slate, slate and shale, talc and soapstone, zinc oxide; in 1910: Slate, slate and shale, talc, zinc oxide.
c Includes in 1909: Fluorspar, gypsum, pottery, salt; in 1910: Fluorspar, gypsum, mica, pottery, salt.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

NEW YORK.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Cement, natural.....barrels..	545,500	$267,188	304,598	$150,952
Portland.....do....	2,139,884	1,859,169	3,296,350	2,906,551
Clay products.....	.....	12,157,436	.....	11,871,949
Emery.....short tons..	1,580	[a] 18,185	.....	[a] 15,077
Feldspar.....do....	11,603	33,101	12,412	47,864
Garnet, abrasive.....do....	2,972	[b] 102,315	3,814	[b] 113,574
Glass sand.....do....	.....	(c)	.....	(c)
Graphite.....pounds..	2,498,400	138,905	2,605,000	158,500
Gypsum.....	.....	1,032,650	.....	1,153,977
Iron, pig.....long tons..	1,733,675	27,392,000	1,938,407	32,410,165
Lime.....short tons..	139,233	575,220	146,474	620,564
Metallic paint.....do....	8,244	79,072	11,085	32,208
Mortar colors.....do....			5,200	50,000
Millstones.....	.....	13,138	.....	13,753
Mineral waters.....gallons sold..	8,813,563	948,325	8,780,903	858,635
Natural gas.....	.....	1,222,666	.....	1,678,720
Petroleum.....barrels..	1,134,897	1,878,217	1,053,838	1,414,668
Salt.....do....	10,914,255	[d] 2,646,736	.....	(c)
Sand and gravel.....short tons..	6,394,615	1,822,314	.....	(a)
Sand-lime brick.....	.....	90,402	.....	89,150
Slate.....	.....	107,436	.....	84,822
Stone.....	.....	5,660,598	.....	6,410,688
Talc, fibrous.....short tons..	48,536	359,957	71,710	728,180
Other products.....	.....	[e] 6,715,528	.....	[c] 13,709,626
Total.....	.....	65,120,588	.....	74,519,623

NORTH CAROLINA.

Barytes.....short tons..	.....	(c)	.....	(c)
Clay products.....	.....	$1,302,611	.....	$1,223,664
Copper.....pounds..	120,451	15,659	181,263	23,021
Gems and precious stones.....	.....	479	.....	710
Gold.....fine ounces (troy)..	1,519	31,400	3,120	64,500
Lime.....short tons..	9,881	44,148	9,952	40,455
Mica.....	.....	148,424	.....	230,460
Millstones.....	.....	(c)	.....	(c)
Mineral waters.....gallons sold..	128,171	20,558	143,007	21,380
Monazite and zircon.....pounds..	391,068	47,178	.....	(c)
Sand and gravel.....short tons..	89,181	13,358	62,935	13,406
Sand-lime brick.....	.....	(c)	.....	(c)
Silver.....fine ounces (troy)..	400	200	8,300	4,500
Stone.....	.....	806,659	.....	879,572
Talc and soapstone.....short tons..	5,956	77,983	3,887	69,805
Other products.....	.....	[e] 43,261	.....	[e] 44,649
Total.....	.....	2,551,918	.....	2,616,131

NORTH DAKOTA.

Clay products.....	.....	$269,324	.....	$227,455
Coal.....short tons..	422,047	645,142	399,041	595,139
Natural gas.....	.....	3,025	.....	3,000
Stone.....	.....	(f)	.....	.....
Other products.....	.....	[f] 28,563	.....	[f] 37,689
Total.....	.....	946,054	.....	863,233

[a] Includes small output from Massachusetts.
[b] Includes very small output from North Carolina and New Hampshire.
[c] Includes, in 1909: Aluminum, glass sand, infusorial earth, mica, pyrite, quartz, slate and shale, zinc oxide; in 1910: Aluminum, glass sand, infusorial earth, pyrite, quartz, salt, sand and gravel, slate and shale.
[d] Includes Louisiana.
[e] Includes, in 1909: Barytes, millstones, sand-lime brick; in 1910: Barytes, monazite, millstones, sand-lime brick, tin.
[f] Includes, in 1909: Mineral waters, natural gas, sand and gravel, sand-lime brick, stone; in 1910: Mineral waters, natural gas, sand and gravel, sand-lime brick.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

OHIO.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Cement, Portland	barrels	1,813,521	$1,359,245	1,527,670	$1,279,717
Clay products			30,346,241		31,525,948
Coal	short tons	27,639,641	27,789,010	34,209,668	35,932,288
Glass sand	do	88,054	95,331	139,122	104,285
Grindstones and pulpstones			679,930		699,033
Iron, pig	long tons	5,551,545	93,321,000	5,752,112	88,122,356
Lime	short tons	343,754	1,241,719	415,285	1,647,335
Mineral waters	gallons sold	2,709,060	112,775	2,226,188	95,989
Natural gas			9,966,038		8,626,954
Petroleum	barrels	10,632,793	13,225,377	9,916,370	10,651,568
Pyrite	long tons	9,461	29,003	3,766	12,831
Salt	barrels	3,684,775	993,700	3,673,850	951,963
Sand and gravel	short tons	3,927,319	1,497,965	4,967,392	1,960,929
Sand-lime brick			(a)		(a)
Stone			5,659,052		5,759,563
Other products			a 697,206		a 704,489
Total			187,014,492		188,075,258

OKLAHOMA.

Asphalt	short tons	10,419	$48,130	11,959	$65,244
Clay products			1,032,314		920,921
Coal	short tons	3,119,377	6,253,367	2,646,226	5,867,947
Lead	do	2,268	195,048	1,805	158,840
Mineral waters	gallons sold	563,475	35,194	115,000	4,950
Natural gas			1,806,193		3,490,704
Petroleum	barrels	47,859,218	17,428,990	52,028,718	19,922,660
Salt	do		(b)	2,564	881
Sand and gravel	short tons	681,785	185,812	650,236	186,977
Stone			577,494		631,711
Zinc	short tons	3,008	324,864	2,297	248,076
Other products			b 1,120,732		b 1,489,954
Total			29,008,138		32,988,865

OREGON.

Clay products			$827,963		$876,632
Coal	short tons	87,276	235,085	67,533	235,229
Copper	pounds	245,403	31,902	22,022	2,797
Gold	fine ounces (troy)	40,103	829,000	32,963	681,400
Lead	short tons	6	516		
Lime	do	3,205	29,305	6,742	65,039
Mineral waters	gallons sold	41,100	10,720	88,970	22,989
Natural gas			(c)		(c)
Platinum	fine ounces (troy)	222	5,550		
Sand and gravel	short tons	896,989	379,705	1,432,495	625,405
Silver	fine ounces (troy)	69,600	36,200	43,800	23,600
Stone			(c)		(c)
Other products			c 428,624		c 1,205,715
Total			2,814,570		3,738,806

a Includes in 1909: Bromine, natural and puzzolan cement, gypsum, metallic paint, oilstones, sand-lime brick; in 1910: Bromine, natural and puzzolan cement, gypsum, mortar colors, oilstones, sand-lime brick.

b Includes in 1909: Bromine, Portland cement, gypsum, lime, salt; in 1910: Portland cement, gypsum, lime.

c Includes in 1909: Gypsum, natural gas, pottery, quicksilver; in 1910: Gems and precious stones, gypsum, ocher, pottery, stone.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

PENNSYLVANIA.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Cement:					
Natural	barrels	295,085	$98,673	196,331	$56,777
Portland	do	22,869,614	15,969,621	26,675,978	19,551,268
Clay products			21,186,713		22,094,285
Coal:					
Anthracite	long tons	72,374,249	149,181,587	75,433,246	160,275,302
Bituminous	short tons	137,966,791	130,085,237	150,521,526	153,029,510
Copper	pounds			740,626	94,060
Feldspar	short tons	18,573	111,466	15,091	104,751
Gems and precious stones			150		
Glass sand	short tons	281,120	399,707	434,147	617,200
Gold	fine ounces (troy)	300	6,200		
Graphite	pounds	2,098,000	116,466	1,392,767	82,194
Iron, pig	long tons	10,918,824	175,429,000	11,272,323	180,695,338
Lime	short tons	885,239	2,532,454	877,714	2,440,350
Metallic paint	do			8,063	91,714
Mortar colors	do	16,174	196,067	2,711	33,752
Millstones			(a)		
Mineral waters	gallons sold	2,177,967	240,856	2,536,337	221,685
Natural gas			20,475,207		21,057,211
Ocher	short tons	4,137	45,472	3,642	32,254
Petroleum	barrels	9,299,403	15,424,554	8,794,662	11,908,914
Sand and gravel	short tons	4,918,627	2,113,363	5,242,362	2,357,021
Sand-lime brick			62,255		72,827
Slate			2,892,358		3,740,806
Stone			8,125,723		8,571,518
Other products			[a] 5,167,682		[a] 4,473,836
Total			549,860,811		591,602,573

RHODE ISLAND.

Mineral waters	gallons sold	502,970	$35,438	528,725	$34,703
Stone			(b)		
Other products			[b] 1,168,440		[b] 765,800
Total			1,203,878		800,503

SOUTH CAROLINA.

Clay products			$753,004		$704,590
Glass sand	short tons		(c)		(c)
Gold	fine ounces (troy)	358	7,400	1,829	37,800
Mica					(c)
Mineral waters	gallons sold	372,880	95,885	410,691	78,465
Monazite	pounds	150,863	18,104		(c)
Phosphate rock	long tons	207,954	[c] 910,586	179,659	733,057
Sand and gravel	short tons	299,659	34,514		(c)
Stone			218,045		(c)
Other products			[c] 51,884		[c] 467,459
Total			2,079,422		2,021,371

[a] Includes in 1909: Bromine, puzzolan cement, copper, millstones, pyrite, quartz, salt, slate and shale, sienna, talc umber, zinc oxide; in 1910: Bromine, puzzolan cement, millstones, quartz, salt, sienna, slate and shale, talc, umber, zinc oxide.

[b] Includes in 1909: Clay products, lime, stone, talc, soapstone; in 1910: Clay products, lime, stone, talc.

[c] Includes in 1909: Glass sand, lime; in 1910: Fuller's earth, glass sand, lime, mica, monazite, sand and gravel, stone.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

SOUTH DAKOTA.

Product.		1909.		1910.	
		Quantity.	Value.	Quantity.	Value.
Clay products			$68,660		$71,200
Copper	pounds	41,988	5,458	43	5
Gems and precious stones			2,520		2,537
Gold	fine ounces (troy)	317,998	6,573,600	260,267	5,380,200
Lead	short tons			7	616
Lime	do	5,309	35,982	4,151	25,399
Natural gas			16,164		31,999
Silver	fine ounces (troy)	196,300	102,100	120,600	65,100
Stone			(a)		173,726
Tin			4,832		12,600
Other products			a 795,171		a 330,052
Total			7,604,487		6,093,434

TENNESSEE.

Barytes	short tons		(b)	4,729	$7,281
Clay products			$1,648,872		1,414,288
Coal	short tons	6,358,645	6,920,564	7,121,380	7,925,350
Copper	pounds	19,207,747	2,497,007	16,691,777	2,119,856
Gold	fine ounces (troy)	706	4,300	135	2,800
Iron, pig	long tons	333,845	4,647,000	397,569	5,271,765
Lime	short tons	78,620	251,945	88,679	275,701
Manganese ore	long tons		(b)		
Mineral waters	gallons sold	934,912	76,185	950,511	71,129
Natural gas			350		200
Phosphate rock	long tons	333,003	1,286,193	398,588	1,503,350
Sand and gravel	short tons	911,462	416,473	794,092	416,557
Silver	fine ounces (troy)	65,300	33,900	69,800	37,700
Stone			1,163,915		(b)
Zinc	short tons	695	75,060	925	99,900
Other products			b 679,573		b 2,250,907
Total			19,701,337		21,396,784

TEXAS.

Asphalt	short tons	46,304	$857,204	57,713	$1,040,825
Cement, Portland	barrels	656,361	808,997	1,292,445	1,643,729
Clay products			3,148,463		2,863,930
Coal	short tons	1,824,440	3,141,945	1,892,176	3,160,965
Copper	pounds	3,456	449	2,961	376
Gems and precious stones			234		834
Gold	fine ounces (troy)	19	400	19	400
Lead	short tons	42	3,612	33	2,904
Lime	do	53,578	244,845	48,200	226,952
Mineral waters	gallons sold	1,033,476	98,499	1,241,248	128,549
Natural gas			(c)		(c)
Petroleum	barrels	9,534,467	6,793,050	8,899,266	6,605,755
Quicksilver	flasks	4,188	190,345	3,320	154,413
Salt	barrels	409,315	260,286	382,164	272,568
Sand and gravel	short tons	676,506	246,365	1,006,584	517,225
Silver	fine ounces (troy)	408,100	212,200	364,400	196,800
Stone			(c)		554,619
Other products			c 1,207,174		c 1,012,607
Total			17,214,068		18,383,451

a Includes in 1909: Portland cement, columbite, gypsum, mica, mineral waters, sand and gravel, sand-lime brick, stone; in 1910: Gypsum, mica, mineral waters, sand and gravel, sand-lime brick, tungsten ore.

b Includes in 1909: Barytes, bauxite, Portland cement, glass sand, manganese ore, metallic paint and mortar colors, quartz; in 1910: Bauxite, Portland cement, glass sand, metallic paint, mortar colors, natural gas, ocher, quartz, slate, and stone.

c Includes in 1909: Natural cement, fuller's earth, gypsum, natural gas, pig iron, sand-lime brick, stone: in 1910: Natural cement, fuller's earth, gypsum, natural gas, pig iron, sand-lime brick, tin.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

UTAH.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	28,919	$221,086	35,697	$569,333
Cement, Portland.....barrels..	.....	.....	811,800	1,005,960
Clay products.....	.....	874,159	.....	864,258
Coal.....short tons..	2,266,899	3,751,810	2,517,809	4,224,556
Copper.....pounds..	101,241,114	13,161,345	125,185,455	15,896,553
Gems and precious stones.....	.....	25,713	.....	13,200
Gold.....fine ounces (troy)..	203,818	4,213,300	208,627	4,312,700
Lead.....short tons..	64,534	5,549,924	57,081	5,023,128
Lime.....do....	16,388	116,992	15,625	88,030
Salt.....barrels..	246,935	147,318	249,850	185,889
Silver.....fine ounces (troy)..	10,551,100	5,486,600	10,445,900	5,640,800
Stone.....	.....	(a)	.....	(a)
Zinc.....short tons..	5,960	643,680	7,721	779,898
Other products.....	.....	a 1,087,583	.....	a 627,461
Total.....	.....	35,279,510	.....	39,283,716

VERMONT.

Clay products.....	.....	$83,360	.....	$89,253
Copper.....pounds..	.....	.....	1,935	246
Lime.....short tons..	42,369	209,941	38,667	203,606
Mineral waters.....gallons sold..	66,100	13,326	137,875	16,660
Ocher.....short tons..	492	4,726	609	5,935
Sand and gravel.....do....	82,090	8,752	66,418	19,047
Slate.....	.....	1,841,589	.....	1,894,659
Stone.....	.....	6,324,366	.....	6,282,574
Talc and soapstone.....short tons..	23,626	120,329	25,975	136,674
Other products.....	.....	b 70,540	.....	b 71,755
Total.....	.....	8,676,929	.....	8,720,409

VIRGINIA.

Barytes.....short tons..	.....	(c)	.....	(c)
Clay products.....	.....	$1,956,517	.....	$1,839,687
Coal.....short tons..	4,752,217	4,251,056	6,507,997	5,877,486
Copper.....pounds..	231,971	30,156	105,313	13,375
Gems and precious stones.....	.....	2,500	.....	.....
Glass sand.....short tons..	.....	.....	.....	(c)
Gold.....fine ounces (troy)..	194	4,000	44	900
Iron, pig.....long tons..	391,134	5,683,000	444,976	6,207,415
Lead.....short tons..	.....	.....	87	7,656
Lime.....do....	164,695	627,946	141,257	563,567
Manganese ore.....long tons..	.....	(c)	.....	(c)
Mica.....	.....	4,600	.....	.....
Millstones.....	.....	(c)	.....	5,273
Mineral waters.....gallons sold..	1,504,530	203,455	2,441,923	301,523
Pyrite.....long tons..	114,176	423,283	.....	(c)
Sand and gravel.....short tons..	847,476	281,177	.....	(c)
Silver.....fine ounces (troy)..	6,400	3,300	200	100
Slate.....	.....	180,775	.....	148,721
Stone.....	.....	859,480	.....	1,000,089
Talc and soapstone.....short tons..	26,511	523,942	25,908	510,781
Zinc.....do....	58	6,264	1,168	120,144
Other products.....	.....	c 761,254	.....	c 1,622,270
Total.....	.....	15,802,705	.....	18,224,987

a Includes in 1909: Arsenic, bismuth, Portland cement, graphite, gypsum, mineral waters, petroleum, phosphate rock, pottery, sand and gravel, stone, sulphur; in 1910: Gypsum, mineral waters, oilstones, petroleum, phosphate rock, pottery, sand and gravel, stone, sulphur.

b Includes in 1909: Asbestos, metallic paints and mortar colors, oilstones; in 1910: Asbestos, oilstones, etc.

c Includes in 1909: Barytes, Portland cement, feldspar, gypsum, manganese ore, manganiferous ore, millstones, ocher, rutile, salt, sand-lime brick; in 1910: Barytes, Portland cement, feldspar, glass sand, gypsum, infusorial earth, manganese ore, manganiferous ore, pottery, pyrite, rutile, salt, sand and gravel, sand-lime brick.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

WASHINGTON.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$3,060,486		$3,023,854
Coal.....short tons	3,602,263	9,158,999	3,911,899	9,764,465
Copper.....pounds	120,611	15,679	65,021	8,258
Gems and precious stones		50		
Gold.....fine ounces (troy)	20,753	429,000	38,990	806,000
Lead.....short tons	115	9,890	311	27,368
Lime.....do	39,270	282,628	35,540	267,735
Mineral waters.....gallons sold	39,260	15,958	31,200	12,571
Sand and gravel.....short tons	1,253,632	423,425	1,575,289	481,569
Silver.....fine ounces (troy)	75,200	39,100	204,900	110,600
Stone		(a)		(a)
Tungsten				51,768
Other products		a 2,048,671		a 2,254,842
Total		15,483,886		16,809,030

WEST VIRGINIA.

Clay products		$3,510,097		$3,998,045
Coal.....short tons	51,849,220	44,661,716	61,671,019	56,665,061
Glass sand.....do	169,731	205,102	235,784	282,267
Iron, pig.....long tons	228,282	3,835,000	174,661	2,619,915
Lime.....short tons	89,569	279,263	90,419	274,205
Mineral waters.....gallons sold	233,349	64,730	336,444	81,742
Natural gas		17,538,565		23,816,553
Petroleum.....barrels	10,745,092	17,642,283	11,751,871	15,720,184
Salt.....do	150,492	76,463	155,625	62,955
Sand and gravel.....short tons	386,714	217,136	509,457	192,194
Stone		(b)		1,054,192
Other products		b 1,147,104		b 290,998
Total		89,177,459		105,058,311

WISCONSIN.

Clay products		$1,139,589		$1,176,883
Glass sand.....short tons		(c)		(c)
Lead.....do	3,238	278,468	3,884	341,792
Lime.....do	268,250	1,067,500	248,238	959,405
Mineral waters.....gallons sold	6,101,882	1,132,239	6,400,812	974,366
Sand and gravel.....short tons	1,514,433	412,019		(c)
Stone		2,694,308		2,644,518
Zinc.....short tons	20,381	2,201,148	20,952	2,133,216
Other products		c 5,924,350		c 5,249,163
Total		14,849,621		13,479,343

WYOMING.

Clay products		$67,755		$50,237
Coal.....short tons	6,393,109	9,896,848	7,533,088	11,706,187
Copper.....pounds	433,672	56,377	217,127	27,575
Gold.....fine ounces (troy)	189	3,900	198	4,100
Gypsum		132,719		(d)
Lime.....short tons	226	2,756	143	1,783
Natural gas		(d)		(d)
Silver.....fine ounces (troy)	1,800	900	1,300	700
Stone		37,476		49,001
Other products		d 134,208		d 270,708
Total		10,332,939		12,110,286

a Includes in 1909: Arsenic, Portland cement, metallic paint and mortar colors, sand-lime brick, stone; in 1910: Portland cement, metallic paint, pig iron, pottery, sand-lime brick, stone, leaded zinc, zinc oxide.

b Includes in 1909: Bromine, Portland cement, grindstones, stone; in 1910: Bromine, Portland cement, grindstones.

c Includes in 1909: Natural cement, glass sand, graphite, metallic paint and mortar colors, pig iron, pyrite, quarts, sand-lime brick, zinc-lead, zinc oxide; in 1910: Glass sand, graphite, metallic paint, pig iron, pyrite, quarts, sand and gravel, sand-lime brick, leaded zinc, zinc oxide.

d Includes in 1909: Asbestos, chromite, mineral waters, natural gas, petroleum, phosphate rock, sand and gravel, sulphur; in 1910: Asbestos, gypsum, mineral waters, petroleum, phosphate rock, sulphur.

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Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1909 and 1910—Continued.

MISCELLANEOUS AND UNDISTRIBUTED PRODUCTS.

Product.	1909.		1910.	
	Quantity.	Value.	Quantity.	Value.
Includes in 1909: Antimonial lead, copper, gold, lead, lime, peat, platinum, pottery, salt (Hawaii and Porto Rico), sand and gravel, silver, stone (Hawaii), tungsten ore, etc.; in 1910: Antimonial lead, arsenic, clay products, copper, gold, lead, lime, peat, platinum, salt, sand and gravel, silver, stone	.....	$2,234,635	.....	$2,290,837

RECAPITULATION.

	1909.	1910.	Gain (+) or loss (−).	Percentage of gain (+) or loss (−).
Alabama	$41,982,208	$47,751,109	.....	.....
Alaska	21,194,918	17,191,688	.....	.....
Arizona	43,155,466	43,483,912	.....	.....
Arkansas	5,889,329	5,350,705	.....	.....
California	80,098,581	86,068,347	.....	.....
Colorado	59,190,424	60,357,715	.....	.....
Connecticut	3,480,918	3,505,161	.....	.....
Delaware	876,501	664,073	.....	.....
District of Columbia	244,069	288,949	.....	.....
Florida	9,239,491	9,284,705	.....	.....
Georgia	5,580,643	6,048,253	.....	.....
Idaho	14,908,819	15,437,403	.....	.....
Illinois	143,051,729	141,809,121	.....	.....
Indiana	43,634,615	59,039,303	.....	.....
Iowa	20,342,368	22,730,968	.....	.....
Kansas	29,447,159	28,304,191	.....	.....
Kentucky	16,857,148	21,512,982	.....	.....
Louisiana	7,658,441	10,119,993	.....	.....
Maine	4,376,488	4,713,123	.....	.....
Maryland	12,831,574	15,440,207	.....	.....
Massachusetts	6,779,974	6,077,370	.....	.....
Michigan	55,041,671	47,771,775	.....	.....
Minnesota	5,638,120	6,088,620	.....	.....
Mississippi	1,129,639	840,152	.....	.....
Missouri	50,416,043	52,640,054	.....	.....
Montana	57,492,806	54,388,117	.....	.....
Nebraska	1,599,818	1,552,794	.....	.....
Nevada	29,628,826	34,617,127	.....	.....
New Hampshire	2,156,985	2,146,736	.....	.....
New Jersey	29,626,329	30,888,892	.....	.....
New Mexico	5,870,547	7,704,373	.....	.....
New York	65,120,558	74,519,023	.....	.....
North Carolina	2,551,918	2,616,131	.....	.....
North Dakota	946,054	863,233	.....	.....
Ohio	187,014,492	188,075,258	.....	.....
Oklahoma	29,008,138	32,988,865	.....	.....
Oregon	2,814,570	3,738,806	.....	.....
Pennsylvania	549,860,811	591,602,573	.....	.....
Rhode Island	1,203,878	800,503	.....	.....
South Carolina	2,079,422	2,021,371	.....	.....
South Dakota	7,604,487	6,093,434	.....	.....
Tennessee	19,701,337	21,396,784	.....	.....
Texas	17,214,068	18,383,451	.....	.....
Utah	35,279,510	39,233,716	.....	.....
Vermont	8,676,929	8,720,409	.....	.....
Virginia	15,802,705	18,224,987	.....	.....
Washington	15,483,886	16,809,030	.....	.....
West Virginia	89,177,459	105,058,311	.....	.....
Wisconsin	14,849,621	13,479,343	.....	.....
Wyoming	10,332,939	12,110,286	.....	.....
Total	1,884,244,429	2,001,154,032	.....	.....
Miscellaneous and undistributed	2,228,414	6,290,837	.....	.....
Unspecified products	300,000	300,000	.....	.....
Grand total	1,886,772,843	2,003,744,869	.....	.....

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IMPORTS AND EXPORTS.

The following table shows the value for the calendar years 1909 and 1910 of the imports for consumption and of the exports of the mineral products included in this report as furnished by the Bureau of Statistics of the Department of Commerce and Labor. As has been noted elsewhere, "imports for consumption" may or may not be identical with "total imports" for the calendar year. Thus, total imports valued at $500,000 may all be entered for consumption, or $50,000 of these imports may be entered in bond and be reported for consumption in the following calendar year. These differences tend to equalize. Thus in the five years from 1903 to 1907, inclusive, the general imports of iron ores exceeded the imports for consumption by less than 7,500 long tons in total imports of over 4,603,000 tons. The difference for a single year may, however, be considerable.

The imports of nonmetallic products increased in value $7,981,459, or 7.14 per cent, from $111,654,305 in 1909 to $119,635,764 in 1910, while the exports decreased $3,531,348, or 2.10 per cent, from $168,035,103 in 1909 to $164,503,755 in 1910. The total imports of mineral products, metals and nonmetals, increased $23,118,243, or 11.47 per cent, while the exports in 1910 remained nearly the same as in 1909, the difference in the total of over $273,000,000 being $2,151,712; the exports of metals, however, increased over $5,600,000, or 5.5 per cent, and the exports of nonmetals decreased about $3,500,000, or 2.10 per cent. Copper constituted about 88 per cent of the metallic exports and petroleum and its derivatives about 62 per cent of the nonmetallic exports. Copper constituted about 38 per cent and tin about 31 per cent of the imported metals; gems and precious stones made up about 33 per cent, sodium nitrate 13 per cent, pottery 9 per cent, potassium salts 6.5 per cent, and coal-tar products about 6 per cent of the nonmetallic imports.

Value of imports for consumption and of exports of mineral products in the calendar years 1909 and 1910.

METALS.

Product.	1909	1910	Increase (+) or decrease (−).
IMPORTS.			
Aluminum salts	$29,061	$53,671	
Antimony (metal, regulus, and ore)	714,366	539,755	
Antimony salts	60,353	14,201	
Bauxite	83,956	65,743	
Bismuth	286,516	332,668	
Cadmium	4,559	2,295	
Chromic iron ore	460,758	415,768	
Chromium salts	30,249	21,204	
Cobalt (oxide, ore, and zaffer)	11,696	6,352	
Copper, in ore, matte, ingots, bars, manufactures, etc	38,762,957	40,849,239	
Iron ore	4,579,078	7,832,225	
Pig iron (including scrap)	1,657,307	2,413,219	
Ferrochrome	43,504	79,429	
Ferromanganese	3,396,381	4,341,071	
Ferrophosphorus	5,380	5,171	
Ferrosilicon	430,169	527,157	
Ferrotungsten	93,205	678,534	
Spiegeleisen	356,447	489,047	
Lead, in ore, base bullion, pigs, sheets, manufactures, etc	861,506	755,092	
Manganese ore	1,405,329	1,711,131	
Molybdenum		14,402	
Nickel, in ore, matte, oxide, etc	3,036,273	4,227,838	
Platinum	2,973,948	3,654,664	

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Value of imports for consumption and of exports of mineral products in the calendar years 1909 and 1910—Continued.

METALS—Continued.

Product.	1909	1910	Increase (+) or decrease (−).
IMPORTS—continued.			
Quicksilver	$8,208	$381	.....
Tin	27,558,546	33,913,255	.....
Titanium alloy	.....	767	.....
Tungsten ore	105,506	344,979	.....
Type metal	532,108	485,493	.....
Uranium salts and oxide	12,057	10,176	.....
Zinc, in ore, pigs, sheets, dust, manufactures, etc	a 2,207,155	a 1,027,941	.....
Iridium, osmium, palladium, and rhodium	150,863	180,805	.....
Total	89,857,436	104,994,227	+$15,136,791
Percentage of increase (+) or decrease (−)	.....	.....	+ 16.85
EXPORTS.			
Aluminum and manufactures, etc	567,375	949,215	.....
Copper, in ore, matte, ingots, bars, manufactures, etc	93,919,956	96,554,432	.....
Iron ore	1,365,325	2,074,164	.....
Pig iron (including scrap)	1,399,151	2,499,446	.....
Lead, in ore, base bullion, pigs, sheets, manufactures, etc	509,542	614,158	.....
Nickel, in ore, matte, oxide, etc	4,101,976	4,704,088	.....
Quicksilver	266,243	91,077	.....
Zinc, in ore, pigs, sheets, dust, manufactures, etc	1,222,173	1,558,271	.....
Total	103,351,741	109,034,851	+5,683,110
Percentage of increase (+) or decrease (−)	.....	.....	+ 5.5

NONMETALS.

IMPORTS.			
Alizarin	$1,191,874	$430,393	.....
Aniline salts	553,503	501,369	.....
Arsenic sulphides, etc	303,728	314,306	.....
Asbestos	1,233,659	1,543,249	.....
Asphalt	633,205	785,963	.....
Barytes	54,707	78,239	.....
Barium compounds	399,376	470,449	.....
Borax	11,687	12,397	.....
Burrstones and millstones	22,590	34,763	.....
Cement, hydraulic	627,116	395,526	.....
Clay	295,011	320,891	.....
Clay products:			
Brick and tile, etc	189,536	206,613	.....
Pottery, etc	10,607,212	11,127,405	.....
Coal:			
Anthracite	12,918	42,244	.....
Bituminous	3,628,533	3,975,561	.....
Coal-tar products	8,086,099	7,423,815	.....
Coke	736,120	625,130	.....
Corundum and emery	338,997	816,167	.....
Cryolite	18,427	2,343	.....
Fertilizers	5,099,059	8,351,697	.....
Phosphates, crude	99,060	235,040	.....
Guano	772,674	667,870	.....
Flint and flint pebbles	301,547	307,286	.....
Fluorspar	26,377	135,152	.....
Fuller's earth	101,151	132,545	.....
Gems and precious stones	40,237,509	40,704,487	.....
Granite	190,418	176,912	.....
Graphite	1,854,459	1,872,592	.....
Grindstones	99,153	106,596	.....
Gypsum	425,137	502,111	.....
Hones, oilstones, whetstones	68,018	45,819	.....
Infusorial earth and rotten stone	24,024	116,057	.....
Kaolin or china clay	1,505,779	1,593,472	.....
Lead paints—litharge, orange mineral, red lead, white lead	101,693	106,118	.....
Lime	75,556	63,791	.....
Magnesite and magnesia	1,041,418	1,578,683	.....
Marble and stone	1,472,607	1,392,231	.....
Mica	618,813	724,525	.....
Mineral waters	1,085,177	983,136	.....

a Includes value of zinc content of imported ore not given in text.

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Value of imports for consumption and of exports of mineral products in the calendar years 1909 and 1910—Continued.

NONMETALS—Continued

Product.	1909	1910	Increase (+) or decrease (−).
IMPORTS—continued.			
Monazite and thorium oxide	$27,920	$16,824	
Natural gas	6,060		
Ocher	110,664	131,846	
Peat	47,227	41,938	
Petroleum	276,459	136,292	
Ozokerite and paraffin	1,422,126	1,025,701	
Potassium salts	7,877,955	7,986,480	
Pumice	100,997	104,425	
Pyrite	2,428,580	2,748,647	
Salt	437,827	370,922	
Sand and gravel	106,234	133,757	
Sienna and umber	59,715	76,872	
Slate	7,872	4,127	
Sodium nitrate	[a] 13,332,548	[a] 16,652,117	
Strontium oxide	270	23	
Sulphur	549,632	558,611	
Talc	56,287	106,460	
Thorium nitrate	236,057	219,615	
Venetian red	28,864	21,591	
Zinc oxide	397,084	396,573	
Total	111,654,305	119,635,764	+$7,981,459
Percentage of increase (+) oe decrease (−)			+ 7.14
Grand total	201,511,741	224,629,984	+23,118,243
Percentage + or −			+ 11.47
EXPORTS.			
Asphalt	[b] 425,429	[b] 702,520	
Cement, hydraulic	1,417,534	3,477,981	
Clay products:			
Brick and tile, etc	1,149,892	1,602,913	
Pottery, etc	863,695	1,041,689	
Coal:			
Anthracite	14,141,468	14,785,387	
Bituminous	[c] 24,300,050	[c] 26,685,405	
Coke	3,232,673	3,053,293	
Fertilizers, phosphates, crude	7,644,368	8,234,276	
Lime		127,952	
Marble and stone	1,170,819	1,538,339	
Petroleum	103,838,590	94,107,022	
Paraffin and paraffin wax	7,608,624	7,329,143	
Salt	269,273	320,926	
Slate	209,383		
Sulphur	736,928	552,941	
Zinc oxide	1,026,377	943,968	
Total	168,035,103	164,503,755	−3,531,348
Percentage of increase (+) or decrease (−)			−2.10
Grand total	271,386,844	273,538,606	+2,151,762
Percentage + or −			+ 0.79

[a] Including soda ash valued at $50,919 in 1909 and at $50,774 in 1910.
[b] Asphalt and manufactures of, fiscal year.
[c] Not including bunker coal laden as fuel in vessels in the foreign trade, which aggregated in value $19,719,124 in 1909 and $20,737,407 in 1910; reported separately by Bureau of Statistics.

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If gold and silver are included, for the sake of rounding out the metals mentioned in this report, the metallic imports increased in 1910 about 15.5 per cent, and the metallic exports decreased nearly 23.5 per cent; the total imports increased nearly 13 per cent, and the total exports decreased about 15 per cent. The movements of gold and silver, however, are rather financial than commercial; nevertheless the following table is added to show the results mentioned above:

Value of imports for consumption and of exports of mineral products in the calendar years 1909 and 1910, including gold and silver.

Product.	1909.	1910.	Increase (+) or decrease (−).
IMPORTS.			
Gold (ore, bullion, and coin)	$44,086,966	$59,222,518	.....
Silver (ore, bullion, and coin)	46,187,702	45,878,168	.....
Other metals	89,857,436	104,994,220	.....
Total	180,132,104	209,094,906	+$28,962,802
Percentage + or −	.....	.....	+ 15.5
Total metals	180,132,104	209,094,906	.....
Total nonmetals	111,654,305	119,635,764	.....
Grand total	291,786,409	328,730,670	+$36,944,261
Percentage + or −	.....	.....	+ 12.6
EXPORTS.			
Gold (ore, bullion, and coin)	132,880,821	58,774,822	.....
Silver (ore, bullion, and coin)	57,592,309	57,360,973	.....
Other metals	103,351,741	109,034,851	.....
Total	293,824,871	225,170,646	−$68,654,225
Percentage + or −	.....	.....	− 23.43
Total metals	293,824,871	225,170,646	.....
Total nonmetals	168,035,103	164,503,755	.....
Grand total	461,859,974	389,674,401	−$72,185,573
Percentage + or −	.....	.....	− 15.4

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METALS AND METALLIC ORES IN 1909 AND 1910.

By H. D. McCaskey.

INTRODUCTION.

For the calendar years 1908 and 1909 Waldemar Lindgren published a summary of the domestic production of metals—divided into output from domestic and from foreign sources and measured for uniformity throughout by the short ton of 2,000 pounds—and of the domestic output of metallic ores by classes, measured also by the short ton. For purposes of comparison and contrast this summary filled a need not otherwise supplied, and similar data are here given for 1909 and 1910.

In the detailed chapters on the various metals in the volume "Mineral Resources of the United States," the production is measured in terms of the customary unit, whether the long ton of 2,240 pounds, the metric ton of 2,204.6 pounds, the short ton of 2,000 pounds, the "flask" of 75 pounds, the avoirdupois pound, or the troy ounce. The long ton is used for coal, iron ore, bauxite, pig iron, and steel, particularly in the Eastern States, and for tin, copper, and spelter in England. The metric ton is used on the continent of Europe, in Mexico, and wherever the metric system is in vogue. The "flask" is the customary unit for the measurement of quicksilver except where the metric ton is used; the avoirdupois pound is the unit referred to in defining the tons and the "flask," and is also used for measuring the output of copper, lead, spelter, aluminum, nickel, etc.; the short ton is used for both ore and concentrates in the West, as well as for lead, and spelter; and the troy ounce is used for gold, silver, and platinum and allied rare metals. Were the metric system in commercial use in the United States, this confusion of terms would be avoided; in its absence the production of this country by metal mines and metallurgical plants is summarized, as stated, in terms of the short ton of 2,000 pounds.

The table of metal production gives in the main the output from plants—mills, smelters, refineries, in the United States, and is essentially a measure of the metallurgical industry, for the supplies of ore, matte, unrefined bullion, etc., treated in this country are from both domestic and foreign sources. The attempt is made at subdivision of these two, however, and the production in marketable form of metals from both domestic and foreign mines is therefore given wherever possible. The table of domestic ore production is a measure of the metal-mining industry of the United States alone.

There are, roughly, four stages to be considered in the production of metal in marketable form from crude ore: (1) Mining, (2) milling and concentrating, (3) smelting, and (4) refining. The first

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stage produces crude ore; and both straight concentrating and gold and silver milling plants produce concentrates. Both crude ore and concentrates are treated in both gold and silver amalgamating, cyaniding, and chlorinating plants, and also in smelters, and the products are refined in private refineries and the precious metals in part in the United States mints. As production may be reported, therefore, as metal in raw materials, in unrefined state, or as refined, there may be three sets of figures to represent the metal output, and there may be certain discrepancies between these for the same metal for the same calendar year, owing to time difference, customary losses in metallurgical operations, and difference in activity between mining and treating the ore. In this summary the metals are measured as refined.

METALS.

The following tables show the production of metals in the United States in 1909 and 1910:

Production of metals in the United States in 1909 and 1910, in short tons.

1909.

Metal.	Production from domestic ores.		Production from foreign ores, matte, and unrefined bullion smelted or refined in the United States.		Total production.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Iron (pig)	27,689,883	$397,907,510	[a] 949,000	$13,637,263	28,638,883	$411,544,773
Manganese (spiegeleisen and ferromanganese)			[b] 252,045	7,630,227	252,045	7,630,227
Nickel			10,958	2,927,975	10,958	2,927,975
Aluminum	[c] 17,105	6,575,000			17,105	6,575,000
Gold	165.315	99,673,400	43.830	26,426,232	209.145	126,099,632
Silver	1,876.166	28,455,200	2,509.374	38,058,848	4,385.540	66,514,048
Platinum	.022	15,950	.017	12,490	.039	28,440
Quicksilver	790	957,859			790	957,859
Tin	22	13,094			22	13,094
Copper, stated as refined	532,782	138,523,320	[d] 43,025 [e] 119,703	11,186,500 31,122,780	695,510	180,832,600
Lead, stated as refined	345,255	29,691,930	[f] 74,035 [g] 28,822	6,367,010 2,478,692	448,112	38,537,632
Antimonial lead	8,889	847,731	4,007	383,288	12,896	1,231,019
Zinc, stated as spelter	230,225	24,864,300	25,535	2,757,780	255,760	27,622,080
Total		727,525,294		142,989,085		870,514,379

1910.

Iron (pig)	28,738,632	$396,205,764	[a] 1,590,000	$21,920,550	30,328,632	$418,126,314
Manganese (spiegeleisen and ferromanganese)			[b] 251,363	6,988,921	251,363	6,988,921
Nickel			16,025	4,085,074	16,025	4,085,074
Aluminum	[c] 23,867	8,955,700			23,867	8,955,700
Gold	159.669	96,269,100	42.143	24,868,231	201.812	121,137,331
Silver	1,959.014	30,854,466	2,394.044	37,706,188	4,353.058	68,560,654
Platinum	.027	25,277	.164	156,960	.191	182,237
Quicksilver	772.537	958,153			772.537	958,153
Tin	21	15,187	28	9,401	49	24,588
Copper, stated as refined	535,947	136,130,538	[d] 47,393 [e] 127,680	12,087,822 32,430,720	711,020	180,599,080
Lead, stated as refined	361,827	31,840,776	[f] 76,905 [g] 31,648	6,767,640 2,785,024	470,380	41,393,440
Antimonial lead	10,140	964,406	3,929	373,684	14,069	1,338,090
Zinc, stated as spelter	252,479	27,267,732	16,705	1,804,140	269,184	29,071,872
Total		729,487,099		151,934,355		[h] 881,621,454

[a] Estimated.
[b] Includes domestic.
[c] Includes foreign.
[d] From foreign ores and matte.
[e] From foreign blister copper.
[f] From foreign ores.
[g] From foreign base bullion.
[h] Includes value of domestic output of vanadium, etc.

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Pig iron.—The production of pig iron is reported by long tons and the figures usually include those for spiegeleisen and ferromanganese. Reported in this way the output of 1909 was 25,795,471 long tons and for 1910 it was 27,303,567 long tons.

Steel-hardening metals.—Various alloys of other metals with iron are of importance, particularly for making hard steel. In addition to the iron-manganese compounds—spiegeleisen and ferromanganese—there are for instance ferrochromium, ferrotungsten, ferrotitanium, and ferronickel. The output of most of these alloys is controlled by one or two producers, and the figures of production can not be separately given.

Nickel and cobalt.—The production of nickel and cobalt from domestic ores is nominal. The figures given are for content of nickel in ore and matte "imported for consumption" and practically all from the Canadian nickel deposits. The metallic production of cobalt is insignificant, and cobalt ores are treated mainly for the manufacture of cobalt oxide, which is used in coloring glass and pottery.

Aluminum.—There is only one producer of aluminum in the United States. The figures given are those for consumption.

Gold and silver.—The production of gold and silver is usually given in fine ounces troy. The following table gives the output of domestic plants for 1909 and 1910:

Production of gold and silver in 1909 and 1910, in fine ounces troy.

	Year.	Domestic.	Foreign.	Total.
Gold	1909	4,821,701	1,278,369	6,100,070
	1910	4,657,018	1,229,168	5,886,186
Silver	1909	54,721,500	73,190,003	127,911,593
	1910	57,137,900	69,826,274	126,964,174

The unrefined foreign gold and silver come mainly from western Canada and Mexico, and considerable ore from which gold and silver are by-products of the smelters in base bullion is also received by domestic plants chiefly from these countries.

Quicksilver.—The production of quicksilver is usually reported in flasks of 75 pounds each. The output in 1909 was 21,075 flasks and in 1910 it was 20,601 flasks.

Tin.—The production of tin is usually given in short tons. The consumption in the United States is almost wholly supplied by imports, and American tin ore is partly smelted in England.

Copper.—The domestic copper production is usually reported as blister copper in pounds. The output of blister copper from domestic ores in 1909 was 1,092,959,624 pounds and in 1910 was 1,080,159,509 pounds. Foreign sources for copper refined in the United States are Mexico, Canada, Europe, Peru, and other countries.

Lead.—The production of lead is usually given in short tons. The imports of foreign ores and base bullion for treatment in domestic plants came mainly from Mexico.

Antimonial lead.—The output of antimonial lead is mainly a metallurgical by-product obtained in refining lead bullion.

Zinc.—The production of metallic zinc or spelter is usually stated in short tons. The figures do not include zinc in pigments. Imports of foreign ores are mainly from Mexico.

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METALLIC ORES.

The following table shows the production of crude metallic ores from domestic mines supplied to gold and silver mills, to concentrating plants, and to smelters:

Production of crude metallic ores from domestic mines in 1909 and 1910 in short tons.

	1909	1910
Iron ores	57,294,089	63,716,502
Manganese ores	1,729	2,529
Manganiferous iron ores	18,519	5,791
Chromium ores	670	230
Tungsten ores	13,200	20,000
Titanium ores	1,425	8,000
Aluminum ores	144,593	166,804
Gold ores	9,241,827	9,111,415
Silver ores	513,823	534,879
Quicksilver ores	154,502	123,502
Tin ores	43	8,800
Copper ores:		
Western States	15,748,274	16,853,637
Central States	11,489,672	10,869,561
Eastern States	787,146	774,040
	28,025,092	28,497,238
Lead ores:		
Western States	2,243,840	2,081,545
Central States	3,567,847	3,693,523
Eastern States	.....	6,400
	5,811,687	5,781,468
Zinc and zinc-lead ores:		
Western States	380,650	824,078
Central States	9,788,786	11,154,285
Eastern States	510,172	411,381
	10,679,608	12,389,744
Total	111,900,807	120,366,902

Iron ore.—Under iron ore are included 868,039 short tons of manganiferous iron ore in 1909 and 625,670 short tons in 1910, shipped from Lake Superior mines. The Lake Superior and Clinton hematites are shipped without concentration, but the eastern brown hematites are usually washed to remove clay. The magnetites of New York, of which 1,077,603 short tons were produced in 1909 and 1,369,168 short tons in 1910, are in part concentrated to remove apatite. All of these ores are reported in the table above as shipped or smelted.

Manganese ore.—The production of high-grade manganese ore is mainly from Virginia, and to a smaller degree from Arkansas. The ore is used in the manufacture of brick, glass, and chemicals.

Manganiferous iron ore.—The low-grade manganiferous iron ores from the Lake Superior region are included with the iron ore. The remaining manganiferous iron ores have come mainly from Colorado and Arkansas and were chiefly used in the manufacture of spiegeleisen. There was no output of ore for this use reported for 1910, but a small tonnage from Arkansas was used in blast furnaces in St. Louis. Considerable tonnage of silver-bearing manganese and iron ore from Leadville and other mining districts are annually used as flux in

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western lead smelters, and these tonnages are included under ores of the precious metals.

Chromium ore.—The domestic production of chromium ore has been mainly from California, with minor quantities from Wyoming. The production for 1910 was all from California, and the greater part was used as furnace lining. Other uses of chrome ore, or chromite, for which importations from New Caledonia, Greece, and other countries supply the demand, are the manufacture of ferrochromium for making special steels and of chromium compounds for use as pigments and dyes.

Tungsten ore.—The tonnages of crude tungsten ore given in the tables are estimates based on the concentrates produced.

Vanadium ore.—The domestic production of vanadium ore is very small, and figures for tonnage can not be given. The value of vanadium from domestic sources in 1910 is included in the grand total of value of metals.

Titanium ore.—The domestic output of titanium ore is mainly rutile from Virginia. Some Canadian ilmenite is imported. The chief uses are for making ferrotitanium for steel manufacture and electrodes for arc lights.

Aluminum ore.—The figures given in the ore table for aluminum ores are for bauxite as shipped. The domestic production is from Alabama, Arkansas, Georgia, and Tennessee. In 1910 the United States became the leading producer. Bauxite is used not only as a raw material in the manufacture of metallic aluminum, but also in the manufacture of aluminum salts, of artificial abrasives, and of bauxite brick. Imports of bauxite in 1909 were 20,931 short tons, and in 1910 they were 17,549 short tons, mostly from France.

Gold ore.—The figures given for gold ore include siliceous, pyritic, and other ores in which the predominant value is for gold. The domestic gold output is derived not only from ore, but also from gravels of placer mines. A considerable portion of the gold output is also from copper, lead, and mixed base-metal ores. Exact figures for quantities of gravel washed are not available, but it is estimated that the volume was about 80,000,000 cubic yards, with an average value per yard of 12 cents, for the United States proper, and about 4,418,000 cubic yards, with an average value of $3.66 per yard for Alaska, in 1909; and about 100,000,000 cubic yards, averaging about 11.5 cents per yard in the United States proper, and 3,800,000 cubic yards, averaging about $3.20 per yard in Alaska in 1910.

Silver ore.—The production of silver ore given is mainly of silver-gold ores in which the value of the silver exceeds that of the gold. Of the total tonnage in 1910 about 365,000 tons were credited to Tonapah, Nev., 17,000 tons to other Nevada mines, 54,000 tons to New Mexico, 22,000 tons to Texas, and 63,000 tons (largely of iron-manganese silver ore used as flux in lead smelters from Leadville) to Colorado. Pure silver ore is rare. About two-thirds of the silver production of the United States is derived as a by-product of lead and copper ores.

Quicksilver ore.—No quicksilver ore is imported. Of the domestic output, ore treated in 1909 included 144,989 short tons, averaging 0.4 per cent of metal, in California; 406 tons, averaging 6.5 per cent, in Nevada and Oregon; and 9,107 tons, averaging 1.7 per cent, in Texas. In 1910 the tonnages were 115,306 tons, averaging 0.5 per cent, in

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California; 35 tons, averaging 7.5 per cent, in Nevada; and 8,221 tons, averaging 1.5 per cent, in Texas.

Tin ore.—The domestic production of tin ore was partly from placer operations, mainly in Alaska—and in this case stated as concentrates—and in 1910 partly from deep mines, principally in South Dakota, but also in Texas.

Copper ore.—The copper ores of the Western States are in part concentrated and in part smelted crude. The copper ores of the Central States (that is, Michigan) are always concentrated, and those of the Eastern States, mainly from Tennessee, are smelted crude. The total quantity of copper concentrate produced in 1909 was 2,329,860 short tons, and in 1910, 2,063,824 short tons. A small part of the domestic copper production is derived from gold, lead, and zinc ores.

Lead ore.—The lead ores of the Western and the Central States are generally concentrated. The production of lead concentrate from the Central States, mainly from southeastern Missouri, was 260,640 tons in 1909, and 260,967 tons in 1910. The output of lead concentrates in Idaho, the largest producer in the Western States, was 188,754 tons in 1909, and 189,336 tons in 1910.

The production of lead ore in the Eastern States was all from Virginia in 1910.

Zinc ore.—A considerable part of the production of zinc ore is used in the manufacture of pigments. Except some western ores, which are shipped crude, the zinc ores are generally concentrated, the principal output of concentrates from the Western States coming from Leadville, Colo.

The zinc ore and concentrates of the Eastern States are mainly from Franklin Furnace, N. J., but also from eastern Tennessee and southwestern Virginia. The output from the Central States is mainly from Missouri, Wisconsin, and Kansas, in the order named, and that from the Western States is mainly from Colorado, Montana, New Mexico, and Utah.

The following table shows the production of zinc concentrates in 1909 and 1910:

Production of zinc concentrates in 1909 and 1910 in short tons.

	1909	1910
Western States[a]	38,056	171,653
Central States	374,929	403,893
Eastern States	302,315	334,391
	715,300	909,937

[a] Leadville only for 1909. Includes zinc middlings from Utah in 1910.

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IRON ORE, PIG IRON, AND STEEL.

By ERNEST F. BURCHARD.

INTRODUCTION.

Although the iron and steel industry in the United States in 1910 broke all previous records by a small margin, the total volume of business was not as great as was anticipated at the beginning of the year. The recovery in 1909 from the depression of 1908 was so rapid that preparations for much larger productions of iron ore and pig iron in 1910 were made than were necessary; consequently there was an overproduction, and a gradual depression marked the close of the year. The curve showing pig iron production by months (see fig. 2) affords a graphic index of the trend of the pig-iron industry from the beginning to the end of the year and also a comparison of the conditions in 1910 with those in 1907, 1908, and 1909. From the beginning of the year there was a steady decline in production, with the exception of small rallies in March and October, neither of which brought the production up to that indicated at the beginning of the preceding month. The daily production for December, 1910, averaged about 57,000 tons, as compared with 85,000 tons in December, 1909. The production for December, 1910, was thus down nearly to the level of that for December, 1908. On December 31, 1910, there were 206 furnaces in blast out of a total of 473; on the same date in 1909 there were 338 furnaces in blast out of a total of 469. As a consequence of the active demand the iron-ore output exceeded that of 1909 by 5,734,297 long tons, and that of 1907, which was previously the record year, by 5,169,115 tons. The total quantity of iron ore marketed in 1910, for the purpose of making pig iron—that is, not including stocks left at mines nor iron ore used for fluxing other metallic ores nor in the manufacture of paints—was 56,889,734 long tons, as compared with 51,155,437 tons in 1909 and with 35,924,771 tons in 1908; the output of pig iron in 1910 was 27,303,567 long tons, as compared with 25,795,471 tons in 1909 and with 15,936,018 tons in 1908.

The ore reported as having been used for fluxing other metallic ores during 1910 amounted to 125,172 long tons, valued at $446,996, as compared with 118,892 long tons in 1909, valued at $297,594. The quantity of iron ore sold by the miners for paint during 1910 was reported as 14,798 long tons, valued at $40,101. Prices of iron and steel products in 1910 were at their highest levels at the beginning of the year, but they began to decline early in February, and practically everything but rails declined steadily until August or later, some of the products selling at the lowest prices in December. The following price reductions per ton occurred from the first week in January to

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December 1:[1] Bessemer pig iron, $2; basic pig iron, $3.75; Bessemer billets, $5; open-hearth billets, $6; wire nails, $3; cut nails, $4, etc.

The increase in the production of iron ore in 1910 over that of 1909 was 11.21 per cent, and the increase in the production of pig iron and steel was about 5.85 per cent and 8.93 per cent, respectively.

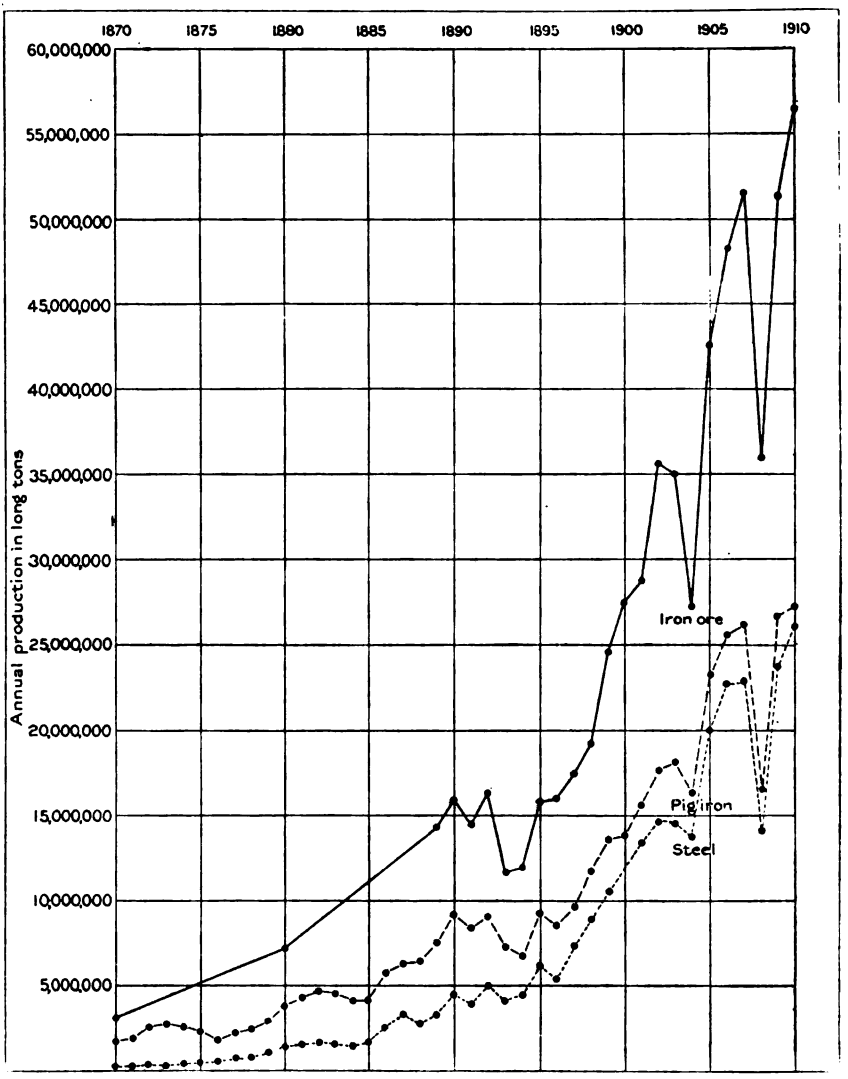

FIGURE 1.—Curve showing the production of iron ore, pig iron, and steel in the United States, 1870–1910, in long tons.

Figure 1 shows graphically the production of iron ore, pig iron, and steel since 1870, and illustrates the major fluctuations that have occurred.

[1] Iron Trade Review, Jan. 5, 1911.

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IRON-ORE INDUSTRY OF THE UNITED STATES.

PRODUCTION OF IRON ORE BY COMMERCIAL DISTRICTS.

The iron ore marketed in the United States in 1910 amounted to 56,889,734 long tons, valued at $140,735,607 at the mines, as compared with 51,155,437 long tons, valued at $109,964,903, produced in 1909. This represents an increase of 11.21 per cent in tonnage and of 27.98 per cent in value. The average price per ton for the whole country in 1910 was $2.47, as compared with $2.15 in 1909.

Iron ore was mined in 28 States during 1910. Of these, four States—Idaho, Montana, Nevada, and Utah—produced ores for fluxing only; part of Colorado's production was for fluxing and part for pig iron; the rest produced ores for blast furnace use.

The various States in which iron ore occurs may be conveniently grouped into six commercial districts, namely:

1. *Northeastern district:* Including Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, and Ohio.
2. *Southeastern district:* Including Maryland, the Virginias, Kentucky, Tennessee, North Carolina, Georgia, and Alabama.
3. *Lake Superior district:* Including Michigan, Wisconsin, and Minnesota.
4. *Mississippi Valley district:* Including Iowa, Missouri, Arkansas, and Texas.
5. *Rocky Mountain district:* Including Idaho, Montana, Wyoming, Colorado, New Mexico, Utah, and Nevada.
6. *Pacific slope district:* Including Washington and California.

Each of these districts may be subdivided into mining districts and the ores classified with regard to variety and to distribution of deposits. These subdivisions are discussed in another section. The Lake Superior is by far the most important of these districts, and is followed in order by the southeastern district and the northeastern district; the Mississippi Valley and the western districts are of minor importance. The following table shows the relative output of iron ore in each of the commercial districts during 1908, 1909, and 1910:

Production of iron ore in the United States, by commercial districts, in 1908, 1909, and 1910, in long tons.

District.	1908.		1909.		1910.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
Northeastern	1,590,098	4.42	2,280,741	4.46	2,605,318	4.58
Southeastern	5,484,821	15.27	6,197,717	12.11	6,894,464	12.12
Lake Superior	28,225,412	78.57	41,942,909	81.99	46,420,226	81.60
Mississippi Valley	154,380	.43	96,428	.19	107,876	.19
Rocky Mountain	470,060	1.31	637,582	1.25	861,850	1.51
Pacific slope	(a)	.....	(a)	.....	(a)	.....
Total	35,924,771	100.00	51,155,437	100.00	56,889,734	100.00

a Pacific slope included in Rocky Mountain district.

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PRODUCTION OF IRON ORE BY STATES.

The following table gives a comparison of the iron-ore production, by States, for 1909 and 1910, showing increase and decrease and the percentage of increase and decrease in the several States:

Quantity and value of iron ore produced in the United States, 1909 and 1910, by States.

State.	1909.		1910.		Increase (+) or decrease (−) in 1910.		Percentage of increase (+) or decrease (−) in 1910.	
	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity.	Value.
Alabama	4,321,252	$4,996,455	4,801,275	$6,083,722	+ 480,023	+$1,087,267	+ 11.11	+ 21.76
California,[a] Colorado, New Mexico, Washington, and Wyoming	637,582	646,062	861,850	877,223	+ 224,268	+ 231,141	+ 35.17	+ 35.78
Connecticut and Massachusetts	38,272	141,274	34,158	121,306	− 4,114	− 19,968	− 10.75	− 14.13
Georgia	221,016	332,478	313,878	482,659	+ 92,862	+ 150,181	+ 42.02	+ 45.17
Kentucky and West Virginia	74,769	110,287	64,347	86,085	− 10,422	− 24,202	− 13.94	− 21.94
Maryland	23,888	46,786	14,062	29,105	− 9,826	− 17,681	− 41.13	− 37.79
Michigan	11,900,384	32,282,622	13,303,906	41,393,585	+1,403,522	+ 9,110,963	+ 11.79	+ 28.22
Minnesota	28,975,149	60,253,314	31,966,769	78,462,560	+2,991,620	+18,209,246	+ 10.32	+ 30.22
Missouri	89,954	210,853	78,341	168,697	− 11,613	− 42,156	− 12.91	− 19.99
New Jersey	543,720	1,607,003	521,832	1,582,213	− 21,888	− 24,790	− 4.03	− 1.54
New York	1,015,333	3,072,323	1,287,209	3,848,683	+ 271,876	+ 776,360	+ 26.78	+ 25.27
North Carolina	61,150	107,013	65,278	114,237	+ 4,128	+ 7,224	+ 6.75	+ 6.75
Ohio	16,527	28,547	22,320	35,866	+ 5,793	+ 7,319	+ 35.05	+ 25.64
Pennsylvania	666,889	792,672	739,799	911,847	+ 72,910	+ 119,175	+ 10.93	+ 15.03
Tennessee	657,795	907,282	732,247	1,048,323	+ 74,452	+ 141,041	+ 11.32	+ 15.55
Texas	6,474	9,318	29,535	34,003	+ 23,061	+ 24,685	+356.20	+264.92
Virginia	837,847	1,693,188	903,377	1,845,144	+ 65,530	+ 151,956	+ 7.82	+ 8.97
Wisconsin	1,067,436	2,727,406	1,149,551	3,610,349	+ 82,115	+ 882,943	+ 7.69	+ 32.37
Total	51,155,437	109,964,903	56,889,734	140,735,607	+5,734,297	+30,770,704	+ 11.21	+ 27.98

[a] No production from California in 1909.

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In the following table the States are arranged according to their rank as producers in 1909 and 1910, with regard to both the quantity and the value of the iron ore produced:

Rank of iron-ore producing States in 1909 and 1910, with quantity and value of product and percentage of each.

1909.

Rank.	State.	Production.		Rank.	State.	Value.	
		Quantity, in long tons.	Percentage of total production.			Amount.	Percentage of total value.
1	Minnesota	28,975,149	56.64	1	Minnesota	$60,253,314	54.79
2	Michigan	11,900,384	23.26	2	Michigan	32,282,622	29.36
3	Alabama	4,321,252	8.45	3	Alabama	4,996,455	4.54
4	Wisconsin	1,067,436	2.09	4	New York	3,072,323	2.79
5	New York	1,015,333	1.98	5	Wisconsin	2,727,406	2.48
6	Virginia	837,847	1.64	6	Virginia	1,693,188	1.54
7	Pennsylvania	666,899	1.30	7	New Jersey	1,607,003	1.46
8	Tennessee	657,795	1.29	8	Tennessee	907,282	.83
9	Colorado, New Mexico, Washington, and Wyoming	637,582	1.25	9	Pennsylvania	792,672	.72
10	New Jersey	543,720	1.06	10	Colorado, New Mexico, Washington, and Wyoming	646,082	.59
11	Georgia	221,016	.43	11	Georgia	332,478	.30
12	Missouri	89,954	.18	12	Missouri	210,853	.19
13	Kentucky and West Virginia	74,769	.15	13	Connecticut and Massachusetts	141,274	.13
14	North Carolina	61,150	.12	14	Kentucky and West Virginia	110,287	.10
15	Connecticut and Massachusetts	38,272	.07	15	North Carolina	107,013	.10
16	Maryland	23,888	.05	16	Maryland	46,786	.04
17	Ohio	16,527	.03	17	Ohio	28,547	.03
18	Texas	6,474	.01	18	Texas	9,318	.01
	Total	51,155,437	100.00		Total	109,964,903	100.00

1910.

1	Minnesota	31,966,769	56.19	1	Minnesota	$78,462,560	55.75
2	Michigan	13,303,906	23.39	2	Michigan	41,393,585	29.41
3	Alabama	4,801,275	8.44	3	Alabama	6,083,722	4.32
4	New York	1,287,209	2.26	4	New York	3,848,683	2.74
5	Wisconsin	1,149,551	2.02	5	Wisconsin	3,610,349	2.57
6	Virginia	903,377	1.59	6	Virginia	1,845,144	1.31
7	California, Colorado, New Mexico, Washington, and Wyoming	861,850	1.52	7	New Jersey	1,582,213	1.12
				8	Tennessee	1,048,323	.75
8	Pennsylvania	739,799	1.30	9	Pennsylvania	911,847	.65
9	Tennessee	732,247	1.29	10	California, Colorado, New Mexico, Washington, and Wyoming	877,223	.62
10	New Jersey	521,832	.92				
11	Georgia	313,878	.55	11	Georgia	482,659	.34
12	Missouri	78,341	.14	12	Missouri	168,697	.12
13	North Carolina	65,278	.11	13	Connecticut and Massachusetts	121,306	.09
14	Kentucky and West Virginia	64,347	.11	14	North Carolina	114,237	.08
15	Connecticut and Massachusetts	34,158	.06	15	Kentucky and West Virginia	86,085	.06
16	Texas	29,535	.05	16	Ohio	35,866	.03
17	Ohio	22,320	.04	17	Texas	34,003	.02
18	Maryland	14,062	.02	18	Maryland	29,105	.02
	Total	56,889,734	100.00		Total	140,735,607	100.00

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PRODUCTION OF IRON ORE BY VARIETIES BY STATES AND MINING DISTRICTS.

Iron minerals are classified as sulphides, oxides, carbonates, silicates, etc., of which only the oxides and the carbonates are used in the iron and steel industry, except a very small quantity of by-product from sulphide ores used in acid manufacture. The ores of iron are generally classed under four heads:

1. *Hematite.*—Including all the anhydrous sesquioxides (Fe_2O_3—theoretical percentage of iron, 70). This is known locally as red hematite, specular ore, gray ore, fossil ore, oolitic ore, etc.

2. *Brown ore.*—Including hydrated sesquioxides, such as limonite, göthite, and turgite ($Fe_2O_3nH_2O$—theoretical percentage of iron, 59.8–66). This is known locally as brown iron ore, brown hematite, bog ore, limonite, etc.

3. *Magnetite.*—Including magnetic oxides (Fe_3O_4—theoretical percentage of iron, 72.4). Magnetite is known generally as magnetic iron ore.

4. *Iron carbonate.*—Including carbonates of various types ($FeCO_3$—theoretical percentage of iron, 48.2). Iron carbonate is known locally as spathic iron ore, kidney ore, black band ore, siderite, etc.

Hematite has always been predominant as an ore of iron, and at present constitutes almost nine-tenths of the iron ore produced. Brown ore and magnetite are far below it in importance; each furnishes at present about one-twentieth of the total iron-ore production. The production of iron carbonate is insignificant in comparison with that of the other ores; it constitutes only about one-thirtieth of 1 per cent of the total.

In the following table are shown the quantities of each of the classes of iron ores produced in the various States during 1909 and 1910:

Production of iron ore in the United States in 1909 and 1910, by States and varieties, in long tons.

1909.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	3,176,416	1,144,836	.....	.....	4,321,252
Colorado, New Mexico, Washington, and Wyoming	542,744	15,000	79,838	.....	637,582
Connecticut and Massachusetts	.....	38,272	.....	.....	38,272
Georgia	9,521	211,495	.....	.....	221,016
Kentucky and West Virginia	45,000	29,769	.....	.....	74,769
Maryland	.....	23,888	.....	.....	23,888
Michigan	11,900,384	.....	.....	.....	11,900,384
Minnesota	28,975,149	.....	.....	.....	28,975,149
Missouri	67,391	22,563	.....	.....	89,954
New Jersey	.....	(a)	a 543,720	.....	543,720
New York	53,187	.....	962,146	.....	1,015,333
North Carolina	.....	.....	61,150	.....	61,150
Ohio	.....	.....	.....	16,527	16,527
Pennsylvania	5,144	80,715	581,030	.....	666,889
Tennessee	298,818	358,977	.....	.....	657,795
Texas	.....	6,474	.....	.....	6,474
Virginia	72,955	762,937	1,955	.....	837,847
Wisconsin	1,061,931	5,505	.....	.....	1,067,436
Total	46,208,640	2,700,431	2,229,839	16,527	51,155,437

a Brown ore is included in magnetite.

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Production of iron ore in the United States in 1909 and 1910, by States and varieties, in long tons—Continued.

1910.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	3,678,139	1,123,136	.....	.....	4,801,275
California, Colorado, New Mexico, Washington, and Wyoming	656,629	15,975	189,246	.....	861,850
Connecticut and Massachusetts	.....	34,158	.....	.....	34,158
Georgia	60,324	253,554	.....	.....	313,878
Kentucky and West Virginia	47,493	16,854	.....	.....	64,347
Maryland	.....	14,062	.....	.....	14,062
Michigan	13,303,906	.....	.....	.....	13,303,906
Minnesota	31,966,769	.....	.....	.....	31,966,769
Missouri	55,832	22,509	.....	.....	78,341
New Jersey	.....	(a)	a 521,832	.....	521,832
New York	64,738	(a)	a 1,222,471	.....	1,287,209
North Carolina	.....	.....	65,278	.....	65,278
Ohio	.....	.....	.....	22,320	22,320
Pennsylvania	846	106,544	632,409	.....	739,799
Tennessee	301,838	430,409	.....	.....	732,247
Texas	.....	29,535	.....	.....	29,535
Virginia	81,647	821,131	599	.....	903,377
Wisconsin	1,148,846	705	.....	.....	1,149,551
Total	51,367,007	2,868,572	2,631,835	22,320	56,889,734

a Brown ore is included in magnetite.

From this table it will be seen that the great bulk of the hematite comes from the Lake Superior district (Michigan, Minnesota, and Wisconsin) and Alabama, the brown ore from the Appalachian States, and the magnetite from New York, New Jersey, and Pennsylvania. All the iron carbonate is obtained from Ohio. On a later page is given the production of the principal ranges in the Lake Superior district. In the report for 1909 the production was given for the first time of two important southern mining centers, the Birmingham and the Chattanooga districts. In the Birmingham district are included, besides the mines in the immediate vicinity of Birmingham, those in eastern Alabama that ship ores to the furnaces at Birmingham. In the Chattanooga district are included those mines that ship ores to Chattanooga, Tenn., to Rome, Ga., and to Gadsden and Attalla, Ala. The brown ore mines near Russellville, Ala., and in west-central Tennessee are not included in either district.

The following table presents the production of iron ore in the principal mining districts and by varieties during 1910:

Production of iron ore in the United States, by mining districts and varieties, in 1910, in long tons.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior	46,328,743	.....	.....	.....	46,328,743
Birmingham	3,390,438	501,062	.....	.....	3,802,115
Chattanooga	712,817	500,742	.....	.....	1,213,559
Adirondack	(a)	.....	a 1,146,080	.....	1,146,080
Northern New Jersey and southeastern New York	.....	(b)	b598,601	.....	598,601
Other	1,018,636	1,866,148	893,532	22,320	3,800,636
Total	51,360,629	2,868,572	2,638,213	22,320	56,889,734

a Hematite is included in magnetite. b Brown ore is included in magnetite.

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TOTAL PRODUCTION OF IRON ORE.

In the following table is shown the production of various types of iron ore in the United States as far as has been recorded. The statistics from 1889 to the present were collected by the United States Geological Survey; those for 1860, 1870, and 1880 were collected for the census reports of those years; those for 1875 and 1881 were estimated by I. L. Bell;[1] and those from 1882 to 1888, inclusive, were estimated by James M. Swank[2] from the pig-iron production. No figures can be obtained for the production of various classes of iron ores prior to 1889, except for the census year 1880.

Production of iron ore in the United States, 1860–1910, in long tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1860					2,873,460
1870					[a] 3,831,891
1875					4,017,857
1880	2,243,993	1,918,622	2,134,276	823,471	7,120,362
1881					7,119,643
1882					[b] 8,700,000
1883					[b] 8,800,000
1884					[b] 7,718,129
1885					[b] 7,600,000
1886					[b] 10,000,000
1887					[b] 11,300,000
1888					[b] 12,062,530
1889	9,056,288	2,523,087	2,506,415	432,251	14,518,041
1890	10,527,650	2,559,938	2,570,838	377,617	16,036,043
1891	9,327,398	2,757,564	2,317,108	189,108	14,591,178
1892	11,646,619	2,485,101	1,971,965	192,981	16,296,666
1893	8,272,637	1,849,272	1,330,886	134,834	11,587,629
1894	9,347,434	1,472,748	972,219	87,278	11,879,679
1895	12,513,995	2,102,358	1,268,222	73,039	15,957,614
1896	12,576,288	2,126,212	1,211,526	91,423	16,005,449
1897	14,413,318	1,961,954	1,059,479	83,295	17,518,046
1898	16,150,084	1,989,681	1,237,978	55,373	19,433,716
1899	20,004,399	2,869,785	1,727,430	81,559	24,683,173
1900	22,708,274	3,231,089	1,537,551	76,247	27,553,161
1901	24,006,025	3,016,715	1,813,076	51,663	28,887,479
1902	30,532,149	3,305,484	1,688,860	27,642	35,554,135
1903	30,328,654	3,080,399	1,575,422	34,833	35,019,308
1904	23,839,477	2,146,795	1,638,846	19,212	27,644,330
1905	37,567,055	2,546,662	2,390,417	21,999	42,526,133
1906	42,481,375	2,781,063	2,469,294	17,996	47,749,728
1907	46,060,486	2,957,477	2,679,067	23,589	51,720,619
1908	31,788,564	[c] 2,561,825	[c] 1,547,797	26,585	[d] 35,924,771
1909	46,208,640	[c] 2,700,431	[c] 2,229,839	16,527	[d] 51,155,437
1910	51,367,007	[c] 2,868,572	[c] 2,631,835	22,320	[d] 56,889,734

[a] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[b] Figures given are for consumption of domestic ores. Total production for 1882, 1883, and 1884 is estimated as 9,000,000, 8,400,000, and 8,200,000 tons, respectively. See Mineral Resources U. S. for 1883 and 1884.
[c] Some brown ore included in magnetite.
[d] Ore used for fluxing purposes excluded from productions figures after 1907. In 1910, ore sold for paint excluded from iron-ore production and included in metallic paint.

In the following table the production of iron ore in the United States is shown from 1810 to 1869, and by decades from 1870 to 1909. The figures for the years previous to 1889 were calculated from the pig-iron production and include imported ore as well as domestic ore used. Ore used for flux has been deducted from the production in 1908 and 1909.

[1] Bell, I. L., Principles of the manufacture of iron and steel, 1884, p. 451.
[2] Mineral Resources U. S., 1882 to 1888.

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Production of iron ore in the United States from 1810 to 1909, by decades, and rate of increase.

Decade.	Quantity in long tons.	Percentage of increase.	Decade.	Quantity, in long tons.	Percentage of increase.
1810–1869	49,656,000		1890–1899	163,989,193	80.1
1870–1879	44,570,527		1900–1909[a]	383,735,101	134.0
1880–1889	91,043,854	104.3			

[a] Iron ore used for flux excluded from production for 1908 and 1909.

PRINCIPAL IRON-ORE MINES.

During 1910, of the 451 iron-ore mines that operated, 191 mines produced over 50,000 long tons of iron ore each, as compared with 150 mines in 1908. In 1909 permission to publish was not requested by the Bureau of the Census in the collection of the statistics of iron-ore production which were furnished to the Geological Survey. The largest quantity produced by any single mine in 1910 was 3,190,093 long tons, from the Hull-Rust mine at Hibbing, on the Mesabi range, Minnesota. Nine mines in Minnesota, besides one group in Alabama and one mine and one group of mines in Michigan, produced more than 1,000,000 tons each, and the second largest quantity was 1,769,067 long tons, produced by the Red Mountain group of mines, between Bessemer and Birmingham, Ala. Permission has been granted to the Survey by the owners and operators of 158 of these mines to publish their production, and this information is given in the following table:

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1910.

Rank.	Names of mines.	States.	Nearest town.	Variety of ore.	Quantity.
1	Hull-Rust	Minnesota	Hibbing	Hematite	3,190,093
2	Red Mountain Group	Alabama	Bessemer	do	1,769,067
3	Fayal	Minnesota	Eveleth	do	1,523,836
4	Mahoning	do	Hibbing	do	1,515,723
5	Morris	do	do	do	1,364,680
6	Adams	do	Eveleth	do	1,288,325
7	Norrie Group	Michigan	Ironwood	do	1,209,335
8	Newport	do	do	do	1,178,058
9	Shenango	Minnesota	Chisholm	do	1,118,865
10	Canisteo	do	Coleraine	do	1,105,173
11	Burt	do	Hibbing	do	1,032,815
12	Leonard	do	Chisholm	do	1,023,410
13	Stevenson	do	Hibbing	do	976,531
14	Sellers	do	do	do	954,044
15	Virginia Group	do	Virginia	do	939,793
16	Hill	do	Marble	do	801,226
17	Chisholm	do	Chisholm	do	684,122
18	Pioneer	do	Ely	do	671,834
19	Spruce	do	Eveleth	do	658,293
20	Cornwall	Pennsylvania	Miners Village	Magnetite	632,409
21	Leetonia	Minnesota	Hibbing	Hematite	613,789
22	Witherbee, Sherman & Co. (Inc.), Mineville.	New York	Mineville	Magnetite	590,658
23	Chapin	Michigan	Iron Mountain	Hematite	575,720
24	Clark	Minnesota	Chisholm	do	542,294
25	Biwabik	do	Biwabik	do	540,000
26	Woodward	Alabama	Woodward	do	456,959
27	Holman	Minnesota	Taconite	do	414,388
28	Kinney	do	Buhl	do	401,817
29	Vulcan	Michigan	Vulcan	do	400,549
30	Pewabic	do	Iron Mountain	do	380,000
31	Sliver	Minnesota	Virginia	do	354,242
32	Bristol	Michigan	Crystal Falls	do	353,200
33	Uno	Minnesota	Hibbing	do	341,961
34	Commodore	do	Virginia	do	341,548
35	Zenith	do	Ely	do	324,893
36	Lake Superior	Michigan	Ishpeming	do	321,370

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Iron-ore mines of the United States that produced more than 50,000 long tons each in 1910—Continued.

Rank.	Names of mines.	States.	Nearest town.	Variety of ore.	Quantity.
37	Glen	Minnesota	Chisholm	Hematite	311,763
38	Lincoln	do	Virginia	do	308,305
39	Hanna, Nos. 1 and 2	do	Mountain Iron	do	305,827
40	Aragon	Michigan	Norway	do	305,020
41	Genoa	Minnesota	Gilbert	do	302,729
42	Virginia	do	Eveleth	do	299,046
43	Grant	do	Buhl	do	297,845
44	Queen Group	Michigan	Negaunee	do	297,284
45	Corsica	Minnesota	McKinley	do	283,210
46	Monroe-Tener	do	Chisholm	do	272,629
47	Albany	do	Hibbing	do	269,929
48	Aurora	Michigan	Ironwood	do	268,906
49	Cary	Wisconsin	Hurley	do	256,807
50	Tobin	Michigan	Crystal Falls	do	254,895
51	Miller	Minnesota	Aurora	do	253,238
52	Susquehanna	do	Hibbing	do	246,563
53	Florence	Wisconsin	Florence	do	246,168
54	Sauntry-Alpena	Minnesota	Virginia	do	245,108
55	Lake Angeline	Michigan	Ishpeming	do	234,484
56	Iroquois	Minnesota	Mountain Iron	do	233,063
57	Utica	do	Hibbing	do	232,734
58	Port Henry, No. 21	New York	Mineville	Magnetite	231,634
59	Caspian	Michigan	Stambaugh	Hematite	223,384
60	Hawkins	Minnesota	Nashwauk	do	222,169
61	Higgins	do	Virginia	do	212,252
62	Colby	Michigan	Bessemer	do	211,711
63	Baltic	do	Stambaugh	do	209,260
64	Bessemer, No. 3 Shaft	Minnesota	Virginia	do	205,968
65	Elba	do	McKinley	do	198,508
66	Brown Mining Co	Tennessee	Cardiff	do	196,438
67	Laura	Minnesota	Hibbing	do	196,309
68	Montreal	Wisconsin	Hurley	do	195,741
69	Cambria	Michigan	Negaunee	do	193,046
70	Mary Charlotte, Nos. 1 and 2	do	do	do	191,838
71	Songo	Alabama	Birmingham	do	189,527
72	Sibley	Minnesota	Ely	do	179,905
73	Ironton	Michigan	Bessemer	do	175,448
74	Republic	do	Republic	do	169,219
75	Mohawk	Minnesota	Aurora	do	168,559
76	Hudson	do	do	do	168,553
77	Hiawatha	Michigan	Iron River	do	168,123
78	Dunn	do	Crystal Falls	do	167,283
79	Crudup	Alabama	Gadsden	do	164,250
80	La Rue	Minnesota	Nashwauk	do	163,987
81	American-Boston	Michigan	Diorite	do	159,250
82	Fowler	Minnesota	Aurora	do	154,127
83	Gilbert	do	Gilbert	do	153,653
84	Adriatic	do	Mesaba	do	152,272
85	Agnew	do	Hibbing	do	151,309
86	Hartford	Michigan	Negaunee	do	147,190
87	Kellogg	Minnesota	Biwabik	do	145,840
88	Greeley	Alabama	Greeley	Brown ore	145,210
89	Riverton Group	Michigan	Iron River	Hematite	140,959
90	Pettit	Minnesota	Gilbert	do	140,798
91	Great Western	Michigan	Crystal Falls	do	136,370
92	Myers	Minnesota	Chisholm	do	134,562
93	Loretto	Michigan	Loretto	do	128,991
94	Woodstock	Alabama	Woodstock	Brown ore	127,647
95	Tilden	Michigan	Bessemer	Hematite	124,043
96	Yale [a]	do	do	do	120,922
97	Mansfield	do	Crystal Falls	do	120,604
98	Raimund, No. 1	Alabama	Bessemer	do	118,675
99	Breitung Hematite, Nos. 1 and 2.	Michigan	Negaunee	do	117,077
100	Brotherton	do	Wakefield	do	116,479
101	Buckeye	Wisconsin	Commonwealth	do	115,063
102	Hartley	Minnesota	Chisholm	do	113,512
103	Richard	New Jersey	Wharton	Magnetite	112,810
104	Hemlock	Michigan	Amasa	Hematite	110,887
105	Sunday Lake	do	Wakefield	do	110,719
106	Croxton	Minnesota	Chisholm	do	110,025
107	Brunt	do	Mountain Iron	do	109,376
108	Cyprus	do	Hibbing	do	108,751
109	Armenia	Michigan	Crystal Falls	do	107,151
110	Rolling Mill	do	Negaunee	do	103,892
111	Ottawa	Wisconsin	Hurley	do	103,442
112	Minorca	Minnesota	Virginia	do	102,039
113	Raimund, No. 2	Alabama	Bessemer	do	100,741
114	Berkshire	Michigan	Stambaugh	do	99,916
115	Soudan	Minnesota	Soudan	do	99,445

[a] July to December.

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Iron-ore mines of the United States that produced more than 50,000 long tons each in 1910—Continued.

Rank.	Names of mines.	States.	Nearest town.	Variety of ore.	Quantity.
116	Atlantic	Wisconsin	Iron Belt	Hematite	98,870
117	Onondaga	Minnesota	Virginia	do	98,427
118	Richmond	Michigan	Palmer	do	95,248
119	Oriskany	Virginia	Oriskany	Brown ore	95,158
120	Barron and Franklin	Michigan	Humboldt	Hematite	93,995
121	Troy	Minnesota	Eveleth	do	88,253
122	Monica	do	Biwabik	do	87,021
123	Puritan	Michigan	Ironwood	do	86,444
124	Bartow	Georgia	Cartersville	Brown ore	84,059
125	Madeira	Minnesota	Hibbing	Hematite	82,922
126	Malta	do	Gilbert	do	81,976
127	Steinman	Alabama	Birmingham	do	78,557
128	James	Michigan	Iron River	do	78,387
129	Empire	do	Palmer	do	78,135
130	Mayville	Wisconsin	Mayville	do	77,156
131	Antoine	Michigan	Iron Mountain	do	76,341
132	Houston	Alabama	Woodstock	Brown ore	75,544
133	Hector	Minnesota	Biwabik	Hematite	74,333
134	Winifred	do	Hibbing	do	74,226
135	Mannie	Tennessee	Allens Creek	Brown ore	71,905
136	Gibson	Michigan	Amasa	Hematite	70,158
137	Pearson	Minnesota	Nashwauk	do	69,459
138	Genessee	Michigan	Crystal Falls	do	68,376
139	Champion	Alabama	Oneonta	Brown ore	67,024
140	Riverside, No. 575	Georgia	Cartersville - Emerson.	do	66,612
141	Eureka	Michigan	Ramsay	Hematite	66,219
142	Cranberry	North Carolina.	Cranberry	Magnetite	65,278
143	Savoy	Minnesota	Ely	Hematite	63,033
144	Pearce	do	Chisholm	do	62,249
145	Knox	do	Mesaba	do	61,680
146	Spaulding	Alabama	Birmingham	do	58,750
147	Mississippi	Minnesota	Hibbing	do	57,907
148	Bray	do	Keewatin	do	57,789
149	Duluth	do	Biwabik	do	57,239
150	Chamberlain	Tennessee	Chamberlain	do	57,023
151	Chatham	Michigan	Iron River	do	56,004
152	Stegmiller	do	Swanzy	do	55,378
153	Valley View	Alabama	Birmingham	do	54,403
154	Euclid	Minnesota	Chisholm	do	53,009
155	Section 30	do	Ely	do	51,250
156	Zimmerman	Michigan	Iron River	do	51,142
157	Tecumseh	Alabama	Tecumseh	Brown ore	50,964
158	Victoria	Minnesota	Virginia	Hematite	50,173
	Total (158 mines)				48,111,574
	Unspecified (33 mines) [a]				5,449,951
	Grand total				53,561,525

[a] Includes the output of 33 mines producing over 50,000 long tons each, operated by 14 companies, which object to the publication of individual statistics.

STOCKS OF IRON ORE AT MINES.

Considerable stock was left at the mines at the end of 1910 which is not included in the production. On December 31, 1910, this stock amounted to 9,408,235 tons, as compared with 6,135,171 tons on December 31, 1909. Besides this stock at the mines, stocks are left at receiving ports and furnaces, but these are included in the annual production.

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The following table shows the tonnage of stock left at the mines on December 31, 1909 and 1910, in the various States:

Stock of iron ore on hand at the mines December 31, 1909 and 1910, by States, in long tons.

State.	1909.	1910.	State.	1909.	1910.
Alabama	717,153	716,340	New York	247,286	119,139
California	97	.....	Ohio	9,802	17,430
Colorado	700	.....	Pennsylvania	4,400	11,839
Georgia	46,385	4,090	Tennessee	20,357	14,848
Kentucky	400	.....	Texas	.....	10,600
Maryland	29	1,020	Virginia	1,000	11,348
Massachusetts	711	4,281	Washington	1,000	.....
Michigan	3,186,211	4,698,565	Wisconsin	107,077	286,266
Minnesota	1,678,540	3,486,277			
Missouri	250	8,625	Total	6,135,171	9,408,235
New Jersey	113,773	17,567	Percentage of increase in 1910	.....	53.35

PRICE OF IRON ORE PER TON.

In the following table the price per ton of the different classes of iron ore in 1909 and 1910 is given for each of the producing States or groups of States. The total average prices per long ton in 1910 were: Hematite, $2.52; brown ore, $1.76; magnetite, $2.36; carbonate, $1.61, as compared with prices, respectively, of $2.17, $1.68, $2.40, and $1.73 in 1909. These figures represent the value at the mines and are taken directly from statements of the producers. They should be accepted as only approximately correct. The element of inaccuracy arises from the fact that by far the greater bulk of the iron ore produced in the United States is mined by pig iron producers for their own furnaces, and the value placed on such ore is therefore largely a matter of accounting. Some of the reports made to the Survey evidently include merely actual mining costs; others contain an allowance for sinking fund; and in still others the figures given are merely convenient prices to use in charging costs against the blast furnaces.

It is to be noted, however, that the errors are almost entirely in one direction—that of undervaluing the ore rather than of overvaluing it. If all the iron ore were to be bought by blast furnaces in open market from an entirely distinct set of iron-ore producers, the average prices paid would probably be considerably in excess of those now reported. It is of interest to compare the prices given below with those of the Lake Superior ores at the lower Lake ports given in a subsequent table.

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Average price per long ton of iron ore in the United States in 1909 and 1910, by States and varieties.

State.	Hematite.		Brown ore.		Magnetite.		Carbonate.	
	1909.	1910.	1909.	1910.	1909.	1910.	1909.	1910.
Alabama	$1.07	$1.19	$1.41	$1.53	.....	.....	.....	.....
California, Colorado, New Mexico, Washington, and Wyoming	1.00	1.00	1.57	1.94	$1.00	$1.00	.....	.....
Connecticut and Massachusetts	.....	.....	3.09	3.55	.....	.....	.....	.....
Georgia	1.69	1.54	1.50	1.53	.....	.....	.....	.....
Kentucky and West Virginia	1.25	1.25	1.82	1.59	.....	.....	.....	.....
Maryland	.....	.....	1.96	2.07	.....	.....	.....	.....
Michigan	2.71	3.11	.....	.....	.....	.....	.....	.....
Minnesota	2.08	2.45	.....	.....	.....	.....	.....	.....
Missouri	2.49	2.23	1.92	1.96	.....	.....	.....	.....
New Jersey	.....	.....	2.53	3.87	2.96	3.03	.....	.....
New York	1.88	2.21	.....	3.00	3.09	3.03	.....	.....
North Carolina	.....	.....	.....	.....	1.75	1.75	.....	.....
Ohio	.....	.....	.....	.....	.....	.....	$1.73	$1.61
Pennsylvania	2.36	2.34	2.41	2.60	1.01	1.00	.....	.....
Tennessee	1.30	1.25	1.45	1.56	.....	.....	.....	.....
Texas	.....	.....	1.44	1.15	.....	.....	.....	.....
Virginia	1.76	1.74	2.05	2.07	2.00	1.50	.....	.....
Wisconsin	2.56	3.14	1.62	2.50	.....	.....	.....	.....
Total average	2.17	2.52	1.68	1.76	2.40	2.36	1.73	1.61

APPARENT ANNUAL IRON-ORE CONSUMPTION.

The following table includes data on certain factors from which an approximate estimate of the annual consumption of iron ore in the United States is deduced. The result is, of course, merely an approximation, for no data are available on certain other factors which should enter into the final result. The elements considered in the table and estimate are (1) domestic iron-ore production; (2) stocks of ore at mines for current year and past year; (3) stocks of ore at Lake ports for current year and past year; (4) zinc residuum production; (5) imports of ore; (6) exports of ore.

Apparent consumption of iron ore in the United States, 1889–1910, in long tons.

Year.	Domestic iron ore produced.[a]	Stocks of ore at mines.	Stocks of ore at lower Lake ports Dec. 1.	Zinc residuum.	Imports.	Exports.	Apparent consumption.
1889	14,518,041	2,256,973	2,607,106	43,648	853,573	.....	14,366,562
1890	16,036,043	2,000,000	3,893,487	48,560	1,246,830	.....	16,302,025
1891	14,591,178	2,450,279	3,508,489	38,228	912,864	.....	15,476,990
1892	16,296,666	2,911,740	4,149,451	31,859	806,585	.....	16,032,687
1893	11,587,629	3,526,161	4,070,710	37,512	526,951	.....	11,616,412
1894	11,879,679	3,236,198	4,834,247	26,981	167,307	.....	11,600,393
1895	15,957,614	2,976,494	4,415,712	43,249	524,153	.....	17,208,255
1896	16,005,449	3,405,302	4,954,984	44,953	682,806	.....	15,765,128
1897	17,518,046	3,098,287	5,923,755	33,924	489,970	.....	17,380,184
1898	19,433,716	2,846,457	5,136,407	48,502	187,208	.....	20,708,604
1899	24,683,173	2,320,278	5,530,283	65,010	674,082	40,665	25,513,903
1900	27,553,161	3,709,950	5,904,670	87,110	897,831	51,460	26,722,583
1901	28,887,479	4,239,823	5,859,663	52,311	966,950	64,703	29,357,171
1902	35,554,135	3,834,717	7,074,254	65,246	1,165,470	88,445	35,886,921
1903	35,019,308	6,297,888	6,371,085	73,264	980,440	80,611	34,232,399
1904	27,644,390	4,666,931	5,763,399	68,189	497,613	213,865	30,224,910
1905	42,526,133	3,812,281	6,438,967	90,289	845,651	208,017	43,433,138
1906	47,749,728	3,281,789	6,252,455	93,461	1,060,390	265,240	49,355,343
1907	51,720,619	3,033,110	7,385,728	93,413	1,229,168	278,608	51,879,998
1908	35,924,771	6,065,397	8,441,533	110,225	776,898	309,099	32,414,703
1909	51,155,437	6,135,171	8,965,789	141,264	1,694,957	455,934	51,941,694
1910	56,889,734	9,408,235	9,426,881	137,173	2,591,031	644,875	56,161,091

[a] Prior to 1908 iron ore used for fluxing included in production. Such ore excluded 1908–1910. Iron ore sold for paint excluded from 1910 production and included in metallic paint.

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COMPARATIVE PRODUCTION OF IRON ORE AND PIG IRON.

Detailed data on the pig-iron production of the United States are presented on later pages of this report, but in the following table an interesting comparison is made between the annual production of iron ore and of pig iron.

Production of iron ore and pig iron in the United States, 1889–1910, in long tons.

Year.	Iron ore mined.[a]	Pig iron produced.[b]	Year.	Iron ore mined.[a]	Pig iron produced.[b]
1889	14,518,041	7,603,642	1900	27,553,161	13,789,242
1890	16,036,043	9,202,703	1901	28,887,479	15,878,354
1891	14,591,178	8,279,870	1902	35,554,135	17,821,307
1892	16,296,666	9,157,000	1903	35,019,308	18,009,252
1893	11,587,629	7,124,502	1904	27,644,330	16,497,033
1894	11,879,679	6,657,388	1905	42,526,133	22,992,380
1895	15,957,614	9,446,308	1906	47,749,728	25,307,191
1896	16,005,449	8,623,127	1907	51,720,619	25,781,361
1897	17,518,046	9,652,680	1908	35,924,771	15,936,018
1898	19,433,716	11,773,934	1909	51,155,437	25,795,471
1899	24,683,173	13,620,703	1910	56,889,734	27,303,567

[a] Prior to 1908, iron ore used for fluxing included in production. Such ore excluded 1908–1910. Iron ore sold for paint excluded from 1910 production and included in metallic paint.
[b] From annual reports of the American Iron and Steel Association.

IRON-ORE INDUSTRY IN THE LAKE SUPERIOR DISTRICT.

Production of iron ore in the Lake Superior district, by ranges.—The Lake Superior district includes the Vermilion, Mesabi, Cuyuna, Penokee-Gogebic, Marquette, and Menominee ranges in the States of Minnesota, Michigan, and Wisconsin. The Menominee range includes the Crystal Falls, Metropolitan, Iron River, and Florence areas; the Marquette range includes the Republic and Swanzy areas. The Baraboo and Iron Ridge areas of southern Wisconsin and the Spring Valley area of northwestern Wisconsin are frequently also included in the Lake Superior district. In the first group of ranges the ore mined is almost entirely Algonkian hematite, belonging to the Huronian series. The Baraboo ore is of the same nature, but the Iron Ridge ore is Clinton hematite, and the Spring Valley ore is brown ore.

In addition to these ranges, there are several iron-ore districts on the Canadian side of the Great Lakes, the principal ones of which are the Michipicoten, the Animikie, the Matawin, and the Atikokan.

The American ranges which produced ore in 1910 were the Vermilion, Mesabi, Penokee-Gogebic, Marquette, and Menominee, besides the Baraboo, Iron Ridge, and Spring Valley areas. Much development work was done on the Cuyuna range, which is expected to show a production in 1911. The following table shows the production of the first five of these for 1909 and 1910, as they constitute the Lake Superior district proper.

The Mesabi range produced 66 per cent of the entire Lake Superior output and about 53.75 per cent of the entire production of the United States. The Menominee, Penokee-Gogebic, and Marquette ranges are next in importance, the Menominee producing a little more and the others a little less than the State of Alabama, which is the next State in importance as a producer after Minnesota and Michigan. The Vermilion range, the last in importance of the five producing Lake Superior ranges, produced more ore in 1910 than New York, which is fourth in importance as a producing State.

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In the following tables is shown the total production of the Lake Superior district by ranges. The figures prior to 1872 were collected by A. P. Swineford, editor Marquette Mining Journal;[1] those for 1872 to 1877, inclusive, are from the Michigan Mineral Statistics; those from 1878 to 1888, inclusive, were collected by W. J. Stevens;[2] and the later figures were collected by the United States Geological Survey.

Production of iron ore in the Lake Superior region, 1909–1910, by ranges.

Range.	1909.	1910.	Increase in 1910.	Percentage of increase in 1910.	Percentage of total production in Lake Superior region.
	Long tons.	*Long tons.*	*Long tons.*		
Marquette (Michigan)	[a] 4,291,967	4,631,427	339,460	7.91	10.00
Menominee (Michigan and Wisconsin)	4,789,362	4,983,729	194,367	4.06	10.76
Gogebic (Michigan and Wisconsin)	[a] 3,807,157	4,746,818	939,661	24.68	10.24
Vermilion (Minnesota)	1,097,444	1,390,360	292,916	26.69	3.00
Mesabi (Minnesota)	27,877,705	30,576,409	2,698,704	9.68	66.00
Total	41,863,635	46,328,743	4,465,108	10.67	100.00

[a] Some Gogebic ore included in Marquette.

Production of Lake Superior iron ore, 1854–1910, by ranges, in long tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Total.
1854–1869	3,112,209					3,112,209
1870	859,507					859,507
1871	813,984					813,984
1872	948,553					948,553
1873	1,195,234					1,195,234
1874	899,934					899,934
1875	881,166					881,166
1876	993,311					993,311
1877	1,014,754	10,375				1,025,129
1878	1,033,082	78,028				1,111,110
1879	1,130,019	245,672				1,375,691
1880	1,384,010	524,735				1,908,745
1881	1,579,834	726,671				2,306,505
1882	1,829,394	1,136,018				2,965,412
1883	1,305,364	1,047,803				2,353,227
1884	1,559,912	895,634	1,022	62,122		2,518,690
1885	1,430,862	690,435	119,590	227,075		2,467,962
1886	1,627,383	880,006	756,237	307,948		3,571,574
1887	1,851,717	1,199,343	1,285,365	394,910		4,731,235
1888	1,918,672	1,191,097	1,433,689	511,953		5,055,411
1889	2,631,026	1,876,157	2,147,923	864,508		7,519,614
1890	2,863,848	2,274,192	2,914,081	891,910		8,944,031
1891	2,778,482	1,856,124	2,041,754	945,105		7,621,465
1892	2,848,552	2,402,195	3,058,176	1,226,220	29,245	9,564,388
1893	2,064,827	1,563,049	1,466,815	815,735	684,194	6,594,620
1894	1,935,379	1,255,255	1,523,451	1,055,229	1,913,234	7,682,548
1895	1,982,080	1,794,970	2,625,475	1,027,103	2,839,350	10,268,978
1896	2,418,846	1,763,235	2,100,398	1,200,907	3,082,973	10,566,359
1897	2,673,785	1,767,220	2,163,088	1,381,278	4,220,151	12,205,522
1898	2,987,930	2,275,664	2,552,205	1,125,538	4,837,971	13,779,308
1899	3,634,596	3,281,422	2,725,648	1,643,984	6,517,305	17,802,955
1900	3,945,068	3,680,738	3,104,033	1,675,949	8,158,450	20,564,238
1901	3,597,089	3,697,408	3,041,969	1,805,996	9,303,541	21,445,903
1902	3,734,712	4,421,250	3,683,792	2,057,532	13,080,118	26,977,404
1903	3,686,214	4,093,320	3,422,341	1,918,584	13,452,812	26,573,271
1904	2,465,448	2,871,130	2,132,898	1,056,430	11,672,405	20,198,311
1905	3,772,645	4,472,680	3,344,551	1,578,626	20,156,566	33,325,018
1906	4,070,914	4,962,357	3,484,023	1,794,186	23,564,891	37,876,371
1907	4,167,810	4,779,592	3,609,519	1,724,317	27,245,441	41,526,579
1908	3,309,917	2,904,011	3,241,931	927,306	17,725,014	28,108,079
1909	4,291,967	4,789,362	3,807,157	1,097,444	27,877,705	41,863,635
1910	4,631,427	4,983,729	4,746,818	1,390,360	30,576,409	46,328,743
Total	97,861,463	76,390,887	66,533,749	30,708,055	226,937,775	498,431,929

[1] Mineral Resources U. S. for 1882, p. 116.

[2] Mineral Resources U. S. for 1891, p. 41.

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Shipments and receipts of Lake Superior ore.—During 1910, 43,442,397 long tons of iron ore were shipped from the Lake Superior district. Of this total 813,639 tons were shipped by rail, the remainder being Lake shipments. Details concerning the shipments and receipts of these ores are given in the following tables, which are taken from the Iron Trade Review:

Shipments of Lake Superior iron ore, 1905–1910, in long tons.[a]

Shipping port.	1905.	1906.	1907.	1908.	1909.	1910.
Two Harbors	7,779,850	8,180,125	8,188,906	5,702,237	9,181,132	8,271,177
Escanaba	5,307,938	5,851,050	5,761,988	3,351,502	5,747,801	4,959,726
Duluth	8,807,569	11,220,218	13,448,736	8,808,168	13,470,503	13,640,166
Ashland	3,485,344	3,388,106	3,436,867	2,513,670	3,834,207	4,094,374
Marquette	2,977,828	2,791,033	3,013,826	1,487,487	2,909,451	3,248,516
Superior	5,118,385	6,083,057	7,440,386	3,564,030	6,540,505	8,414,799
Total	33,476,904	37,513,589	41,290,709	25,427,094	41,683,599	42,628,758
All-rail shipments	907,212	1,052,173	975,959	587,893	903,270	813,639
Grand total	34,384,116	38,565,762	42,266,668	26,014,987	42,586,869	43,442,397

[a] Iron Trade Review.

Iron-ore receipts at Lake Erie ports, 1905–1910, in long tons.[a]

Port.	1905.	1906.	1907.	1908.	1909.	1910.
Ashtabula, Ohio	6,373,779	6,833,352	7,521,859	3,012,064	8,056,941	9,620,638
Cleveland, Ohio	5,854,745	6,604,661	6,495,998	4,240,816	6,051,342	6,344,943
Conneaut, Ohio	5,327,552	5,432,370	5,875,937	4,798,631	7,007,834	6,309,548
Buffalo and Tonawanda, N. Y.	3,774,928	4,928,331	5,580,438	2,835,099	5,002,235	4,704,439
Erie, Pa	2,112,476	1,986,539	2,294,239	828,602	1,235,057	942,592
Fairport, Ohio	2,008,621	1,861,498	2,437,649	1,518,961	1,734,277	1,516,434
Toledo, Ohio	1,000,855	1,423,741	1,314,140	680,553	1,374,224	1,225,202
Lorain, Ohio	1,605,823	2,191,965	2,621,025	2,286,388	2,796,856	2,884,738
Huron, Ohio	825,278	778,453	971,430	213,377	243,082	197,951
Sandusky, Ohio	51,202	35,847	83,043	.....	11,088	.....
Total	28,941,259	32,076,757	35,195,758	20,414,491	33,512,936	33,746,485

[a] Iron Trade Review.

The following table shows the total quantity of iron ore shipped from the Lake Superior district since 1854, the date of the opening of the Marquette range, the oldest of the Lake Superior ranges. This table gives the shipments as collected by the Iron Trade Review and is inserted for comparison with the table giving the total production of the Lake Superior district, without regard to shipments:

Shipments of iron ore from the Lake Superior region, 1854–1910, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1854	3,000	1874	919,557	1894	7,748,932
1855	1,449	1875	891,257	1895	10,429,037
1856	36,343	1876	992,764	1896	9,934,828
1857	25,646	1877	1,015,087	1897	12,469,638
1858	15,876	1878	1,111,110	1898	14,024,673
1859	68,832	1879	1,375,691	1899	18,251,804
1860	114,401	1880	1,908,745	1900	19,059,393
1861	49,909	1881	2,306,505	1901	20,589,237
1862	124,169	1882	2,965,412	1902	27,571,121
1863	203,055	1883	2,353,288	1903	24,239,878
1864	243,127	1884	2,518,692	1904	21,822,839
1865	236,208	1885	2,466,372	1905	34,384,116
1866	278,796	1886	3,568,022	1906	38,565,762
1867	473,567	1887	4,730,577	1907	42,266,668
1868	491,449	1888	5,063,693	1908	26,014,987
1869	617,444	1889	7,292,754	1909	42,586,869
1870	830,940	1890	9,012,379	1910	43,442,397
1871	779,607	1891	7,062,233		
1872	900,901	1892	9,069,556	Total	492,793,542
1873	1,162,458	1893	6,060,492		

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Stocks of iron ore at Lake Erie ports.—At the close of navigation in 1910 the stocks of iron ore at the Lake Erie ports exceeded those of the same date in 1909 by 461,092 tons; and the stocks of 1909 exceeded those of 1908 by 524,256 tons.

The following statistics from the Iron Trade Review contain data as to the stocks of iron ore at the Lake Erie ports at the close of navigation and at the opening of navigation for the last six years:

Stocks of iron ore at lower Lake ports, December 1, 1905–1910, in long tons.[a]

Port.	At close of navigation, December 1—					
	1905.	1906.	1907.	1908.	1909.	1910.
Ashtabula, Ohio	1,589,951	1,631,312	2,056,820	2,293,531	2,594,359	3,287,816
Cleveland, Ohio	1,330,619	1,224,606	1,281,335	1,458,392	1,547,142	1,638,795
Fairport, Ohio	759,961	590,783	523,981	835,821	867,640	839,970
Erie, Pa	564,961	552,631	652,219	730,530	788,046	792,011
Lorain, Ohio	271,695	336,321	366,271	426,274	407,129	259,448
Conneaut, Ohio	976,976	1,057,424	1,090,774	1,296,675	1,411,002	1,329,997
Toledo, Ohio	368,024	281,000	518,645	590,925	332,456	433,215
Huron, Ohio	208,023	245,499	415,730	458,158	477,333	375,118
Buffalo, N. Y	315,790	315,412	435,407	315,148	501,125	452,783
Sandusky, Ohio	52,977	17,467	44,546	36,079	39,557	17,728
Total	6,438,967	6,252,455	7,385,728	8,441,533	8,965,789	9,426,881

[a] Iron Trade Review, May 13, 1909, May 12, 1910, and May 18, 1911.

Stocks of iron ore at lower Lake ports, May 1, 1906–1911, in long tons.[a]

Port.	At opening of navigation, May 1—					
	1906.	1907.	1908.	1909.	1910.	1911.
Ashtabula, Ohio	462,564	568,485	1,799,454	1,392,430	1,609,931	2,277,931
Cleveland, Ohio	350,382	447,573	1,029,198	1,018,055	985,725	1,502,858
Fairport, Ohio	266,162	154,246	225,328	562,679	541,299	633,485
Erie, Pa	169,488	189,276	595,660	557,029	550,187	653,778
Lorain, Ohio	140,452	176,300	327,052	362,096	205,445	346,849
Conneaut, Ohio	148,528	139,853	462,392	497,203	461,365	419,421
Toledo, Ohio	52,550	147,397	217,788	380,675	366,631	383,761
Huron, Ohio	80,738	98,106	392,731	379,364	336,693	273,042
Buffalo, N. Y	90,906	50,313	388,441	189,209	364,336	347,702
Sandusky, Ohio	29,320	5,439	42,256	31,528	22,468	11,458
Total	1,791,090	1,976,988	5,480,300	5,370,268	5,444,080	6,850,285

[a] Iron Trade Review, May 13, 1909, May 12, 1910, and May 18, 1911.

Prices of Lake Superior iron ore.—In the following table are given the prices of Lake Superior iron ore at the lower Lake ports during 1909 and 1910.

The base for the Bessemer ore is a metallic iron content of 55 per cent; that of the non-Bessemer ore is a metallic iron content of 51.5 per cent.

Base prices per long ton of Lake Superior iron ore at lower Lake ports, 1909–1910.

	1909.	1910.[a]		1909.	1910.[a]
Old range:			Mesabi:		
Bessemer	$4.50	$5.00	Bessemer	$4.25	$4.75
Non-Bessemer	3.70	4.20	Non-Bessemer	3.50	4.00

[a] Iron Trade Review, Jan. 13, 1910.

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FOREIGN TRADE IN IRON ORE.

IMPORTS.

The quantity of iron ore imported into the United States in 1910 exceeded the imports of any year heretofore recorded. The imports of 1910 exceeded those of 1909 by 53 per cent. About 56 per cent of the imports were from Cuba, about 17 per cent from Spain, about 10 per cent from Sweden, and the bulk of the rest was from Newfoundland, the imports from which decreased 7 per cent from those of 1909. The statistics with regard to imports are furnished by the Bureau of Statistics of the Department of Commerce and Labor.

In the following table are shown the imports of iron ore from the various countries from 1907 to 1910, inclusive:

Quantity and value of iron ore imported into the United States in the calendar years 1907–1910, by countries, in long tons.

Country.	1907.		1908.		1909.		1910.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	657,133	$2,522,710	579,668	$1,756,091	927,774	$2,681,028	1,451,096	$4,459,789
Spain	296,318	760,801	126,074	331,070	291,547	664,460	439,868	1,040,589
French Africa	65,940	252,897	.....	.....	37,208	67,515	15,471	36,791
Greece	23,800	42,927	4,850	5,311	19,080	21,782	39,060	71,951
Newfoundland and Labrador	89,685	97,735	48,285	48,285	224,395	330,056	209,006	343,892
United Kingdom	5,765	16,491	2,028	32,027	869	12,846	11,388	52,591
Germany	273	2,096	602	4,052	3	100	3	58
Netherlands	500	3,673	.....	.....	.....	.....	.....	.....
Canada	26,878	51,328	5,013	16,321	27,155	84,613	95,005	251,086
Belgium	125	1,102	1	28	3	179	158	644
Russia in Europe	.....	.....	.....	.....	32,010	62,418	12,570	48,279
Sweden	.....	.....	4,617	15,783	120,564	627,315	259,911	1,391,976
Other countries	62,751	185,723	5,760	15,280	[a] 14,349	26,766	[b] 57,495	134,579
Total	1,229,168	3,937,483	776,898	2,224,248	1,694,957	4,579,078	2,591,031	7,832,225

[a] Other countries in 1909: Colombia and Mexico.
[b] Other countries in 1910: Chinese Empire, Colombia, Egypt, British South Africa, etc.

The following table shows the imports of iron ore into the United States from 1907 to 1910, inclusive, by ports of entry:

Quantity and value of iron ore imported into the United States in the calendar years 1907–1910, by customs districts, in long tons.

Customs district.	1907.		1908.		1909.		1910.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baltimore	639,602	$2,436,457	248,875	$844,436	628,577	$1,838,762	1,137,916	$3,575,059
Boston	479	2,071	21	61	7	29	235	853
Charleston	500	3,673	500	3,070	.....	.....	.....	.....
New York	7,405	19,989	4,392	17,424	47,285	93,277	78,556	213,282
Perth Amboy	.....	.....	1,355	23,637	.....	.....	.....	.....
Philadelphia	554,104	1,422,503	516,619	1,318,182	991,983	2,559,760	1,269,180	3,775,770
Savannah	100	630	.....	.....	.....	.....	.....	.....
Chicago	.....	.....	.....	.....	.....	.....	7,679	22,610
Los Angeles	.....	.....	51	501	.....	.....	.....	.....
Puget Sound	1,976	6,365	.....	.....	.....	.....	25,000	47,750
San Francisco	100	832	50	446	.....	.....	.....	.....
Buffalo Creek	172	96	.....	.....	141	489	4,200	4,473
Champlain	5	20	10	30	40	75	29	73
Cuyahoga	18,866	33,393	1,712	3,030	3,500	15,250	.....	.....
Detroit	.....	.....	.....	.....	25	777	306	765
Erie	5,400	9,558	.....	.....	4,000	16,700	.....	.....
Miami	.....	.....	2,569	9,403	18,106	46,106	63,966	172,824
Niagara	292	652	23	40	596	2,310	2,343	11,166
Oswegatchie	.....	.....	23	60	.....	.....	25	75
Vermont	167	1,244	676	3,758	455	2,054	137	1,509
St. Louis	.....	.....	22	170	.....	.....	.....	.....
Genesee	.....	.....	.....	.....	17	895	10	553
Other districts	.....	.....	.....	.....	225	2,594	1,449	5,463
Total	1,229,168	3,937,483	776,898	2,224,248	1,694,957	4,579,078	2,591,031	7,832,225

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In the following table is shown the importation of iron ore into the United States as far as has been recorded. Iron ore was imported from Europe in large quantities for the first time in 1879, most of the ore prior to that date coming from Canada.

Imports of iron ore into the United States, 1872–1910, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1872	23,733	1885	390,786	1899	674,082
1873	45,981	1886	1,039,433	1900	897,831
1874	57,987	1887	1,194,301	1901	966,950
1875	56,655	1888	587,470	1902	1,165,470
1876	17,284	1889	853,573	1903	980,440
1877	30,669	1890	1,246,830	1904	487,613
1878	28,212	1891	912,864	1905	845,651
1879 [a]	150,197	1892	806,585	1906	1,060,390
1879 [b]	284,141	1893	526,951	1907	1,229,168
1880	493,408	1894	167,307	1908	776,898
1881	782,887	1895	524,153	1909	1,694,957
1882	589,655	1896	682,806	1910	2,591,031
1883	490,875	1897	489,970		
1884	487,820	1898	187,208		

[a] Fiscal years end. [b] Calendar years begin.

EXPORTS.

The quantity of iron ore exported from the United States in 1910 amounted to 644,875 long tons, an increase of more than 41 per cent over iron-ore exports in 1909.

In the following table is shown the exportation of iron ore from the United States, by customs districts, from 1907 to 1910, inclusive. The data regarding exports are collected by the Bureau of Statistics, Department of Commerce and Labor.

Quantity and value of iron ore exported from the United States in the calendar years, 1907–1910, by customs districts, in long tons.

Customs district.	1907.		1908.		1909.		1910.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Newport News	77	$419	.....	.....	.....	.....	.....	.....
Savannah	.....	.....	.....	.....	.....	.....	10	75
Norfolk and Portsmouth	18	240	.....	.....	3	$27	.....	.....
Arizona	206	1,098	.....	.....	.....	.....	.....	.....
Buffalo Creek	.....	.....	25	$140	336	1,506	1,203	6,054
Champlain	14,855	44,595	7,359	22,517	9,417	27,170	19,941	71,740
Detroit	4	47	4	46	.....	.....	.....	.....
Duluth	43,513	150,722	52,509	187,059	129,231	471,088	187,042	650,654
Niagara	60	195	3,097	7,289	6,887	21,819	2,848	12,956
Superior	219,761	565,644	244,408	789,306	306,270	830,415	415,396	1,283,824
Vermont	114	462	1,697	6,567	.....	.....	.....	.....
Puget Sound	.....	.....	.....	.....	3,790	13,300	18,435	48,861
Total	278,608	763,422	309,099	1,012,924	455,934	1,365,325	644,875	2,074,164

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The quantity of iron ore exported from the United States, as far as has been recorded, is shown in the following table:

Exports of iron ore from the United States, 1899–1910, in long tons.

Year.	Quantity.	Year.	Quantity.
1899	40,665	1905	208,017
1900	51,460	1906	265,240
1901	64,703	1907	278,608
1902	88,445	1908	309,099
1903	80,611	1909	455,934
1904	213,865	1910	644,875

IRON-ORE INDUSTRY OF CUBA.

The iron ores which have been mined in Cuba up to the present time consist largely of hematite and magnetite and are obtained near Santiago, in the Province of Oriente (Santiago). Recently large deposits of brown ore have been attracting considerable attention, especially those of the Mayari and the Moa fields, in Oriente Province, and those of the Cubitas field, in Camaguey Province. No ores of this type were reported as mined in 1909, but there was a considerable production in 1910. Several interesting papers have been published by the American Institute of Mining Engineers on Cuban iron ores within the last year, and these are listed in the bibliography at the end of this chapter.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the Cuban iron-ore production were collected by the United States Geological Survey.

Shipments of iron ore from mines in the Province of Oriente (Santiago), 1884–1910, in long tons.

Year.	Juragua Iron Co. (Limited).	Sigua Iron Co.	Spanish-American Iron Co.	Cuban Steel Ore Co.	Ponupo Manganese Co.	Total.
1884	25,295					25,295
1885	80,716					80,716
1886	112,074					112,074
1887	94,240					94,240
1888	206,061					206,061
1889	260,291					260,291
1890	363,842					363,842
1891	264,262					264,262
1892	335,236	6,418				341,654
1893	337,155	14,020				351,175
1894	156,826					156,826
1895	307,503		74,991			382,494
1896	298,885		114,110			412,995
1897	[a] 248,256		[b] 206,029			454,285
1898	83,696		84,643			168,339
1899	161,783		215,406			377,189
1900	154,871		292,001			446,872
1901	199,764		[c] 334,833	17,651		552,248
1902	221,039		455,105	23,590		699,734
1903	155,898		467,723			623,621
1904	31,162		356,111			387,273
1905	139,828		421,331			561,159
1906	133,379		507,195			640,574
1907	181,063		500,330			681,393
1908	366,580		452,854			819,434
1909	356,659		514,066		59,721	930,446
1910	318,814		934,092		165,008	1,417,914

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons were sent to foreign ports.
[c] Of this quantity, 12,691 tons were sent to foreign ports.

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WORLD'S PRODUCTION OF IRON ORE.

The latest available statistics with regard to the world's production of iron ore are shown in the following table. Of the figures in this table, those for the United States, Great Britain, Cuba, Canada, India, and Australia are in long tons; those for the other countries are in metric tons.

World's production of iron ore in 1908 and 1909, by countries.

Country.	1908.	1909.
	Tons.	*Tons.*
United States	35,924,771	51,155,437
Germany and Luxemburg	24,278,151	25,506,000
United Kingdom	15,031,025	14,979,979
Spain	9,271,592	(a)
France	10,057,145	11,890,000
Russia	(a)	(a)
Sweden	4,713,160	(a)
Austria-Hungary	4,718,700	(b)
Canada	c 212,573	c 239,324
Newfoundland	935,154	c 991,115
Cuba	930,446	1,417,914
Algeria	943,424	891,000
Tunis	148,000	218,000
Greece	515,368	(a)
Italy	539,120	531,000
Belgium	188,780	200,000
China d	133,458	(a)
India	72,300	83,456
Japan	(a)	(a)
Norway	119,656	(a)
Australia	55,194	(a)

a Not available.
b Austria produced 2,490,000 tons. Figures for Hungary not available.
c Shipments.
d Exports.

IRON AND STEEL INDUSTRY OF THE UNITED STATES.

PRODUCTION AND VALUE OF PIG IRON BY STATES.

The production of pig iron in 1910 amounted to 27,303,567 long tons, valued f. o. b. at the furnaces at $425,115,235, as compared with 25,795,471 long tons, valued at $419,175,000, in 1909, an increase in quantity of 1,508,096 tons and in value of $5,940,235. The average value per ton in 1910 was $15.57 and in 1909 it was $16.25, a decrease in 1910 of 68 cents per ton. The figures of output of pig iron and steel given herewith are the official statistics of the American Iron and Steel Association, published by James M. Swank, general manager of the association, in his annual statistical reports. The values of pig iron for 1907, 1908, and 1910 were reported to the United States Geological Survey by the manufacturers, and represent the approximate value f. o. b. at the furnaces, therefore eliminating freight costs, commissions, etc., which are included in the market prices of pig iron as published in the trade journals. The value for 1909 is an estimate made on a basis similar to that used in estimating the values prior to 1907. The production of pig iron includes the pig iron, ferromanganese, spiegeleisen, etc., produced from foreign as well as domestic ore, since there are no data at present available for separating out the production derived from domestic ore. The quantity and value of blast furnace products derived from ore imported from Cuba, Spain, Newfoundland and Labrador, and Sweden is considerable,

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but, of course, it constitutes a very small percentage of the total production.

The following table shows the quantity and approximate value of pig iron production in the United States in 1909 and 1910, and the increase or decrease, both by totals and percentages, for the various producing States:

Quantity and value of pig iron produced in the United States in 1909 and 1910, by States, in long tons.

State.	1909.		1910.		Increase (+) or decrease (−) in 1910.		Percentage of increase (+) or decrease (−) in 1910.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	1,763,617	$22,222,000	1,939,147	$23,754,551	+ 175,530	+ $1,532,551	+ 9.95	+ $6.90
Illinois	2,467,156	44,211,000	2,675,646	42,917,362	+ 208,490	− 1,293,638	+ 8.45	− 2.93
Kentucky	86,371	1,398,000	100,509	1,692,572	+ 14,138	+ 294,572	+ 16.37	+ 21.07
Maryland	286,856	4,673,000	326,214	5,230,824	+ 39,358	+ 557,824	+ 13.72	+ 11.94
New Jersey	204,474	4,473,000	264,781	4,204,722	− 29,693	− 268,278	− 10.08	− 6.00
New York	1,733,675	27,392,000	1,938,407	32,410,165	+ 204,732	+ 5,018,165	+ 11.81	+ 18.32
Ohio	5,551,545	93,321,000	5,752,112	88,122,356	+ 200,567	− 5,198,644	+ 3.61	− 5.57
Pennsylvania	10,918,824	175,429,000	11,272,323	180,695,338	+ 353,499	+ 5,266,338	+ 3.24	+ 3.00
Tennessee	333,845	4,647,000	397,569	5,271,765	+ 63,724	+ 624,765	+ 19.09	+ 13.44
Virginia	391,134	5,683,000	444,976	6,207,415	+ 53,842	+ 524,415	+ 13.77	+ 9.23
West Virginia	228,282	3,835,000	174,661	2,619,915	− 53,621	− 1,215,085	− 23.49	− 31.68
California, Colorado, Missouri, Oregon, Washington	382,766	7,370,000	428,612	6,514,902	+ 45,846	− 855,098	+ 11.98	− 11.60
Connecticut, Massachusetts	18,388	650,000	16,582	516,363	− 1,806	− 133,637	− 9.82	− 20.56
Georgia, Texas	26,072	442,000	14,725	323,950	− 11,347	− 118,050	− 43.52	− 26.71
Indiana, Michigan, Minnesota, Wisconsin	964,289	17,570,000	1,250,103	19,751,627	+ 285,814	+ 2,181,627	+ 29.64	+ 12.42
	348,177	5,859,000	307,200	4,881,408	− 40,977	− 977,592	− 11.77	− 16.68
Total	25,795,471	419,175,000	27,303,567	425,115,235	+ 1,508,096	+ 5,940,235	+ 5.85	+ 1.42

The following table gives the annual average price per long ton of pig iron in the United States for the years 1889 to 1910, inclusive. The prices prior to 1907 include the cost of transportation from blast furnaces to markets. The extreme range in prices, from $9.76 in 1894 to $20.92 in 1902, is of interest in view of present manufacturing conditions:

Average price per long ton of pig iron in the United States, 1889–1910.

1889	$15.78	1897	$9.85	1904	$14.13
1890	16.43	1898	9.90	1905	16.63
1891	15.50	1899	18.00	1906	19.98
1892	14.32	1900	18.85	1907	20.56
1893	11.90	1901	15.25	1908	15.96
1894	9.76	1902	20.92	1909	16.25
1895	11.14	1903	19.12	1910	15.57
1896	10.47				

The following table shows the number of blast furnaces in blast on June 30 and December 31, and the total number of stacks recorded, for the years 1909 and 1910:

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Record of blast furnaces in the United States, 1909 and 1910, by States.

State.	Furnaces in blast June 30, 1909.	Dec. 31, 1909.			Furnaces in blast June 30, 1910.	Dec. 31, 1910.		
		In.	Out.	Total.		In.	Out.	Total.
Pennsylvania	103	134	28	162	116	74	90	164
Ohio	44	61	13	74	50	35	41	76
Illinois	19	23	3	26	20	11	15	26
Alabama	19	29	22	51	24	20	30	50
New York	15	17	11	28	18	15	14	29
Virginia	9	13	13	26	11	9	17	26
Tennessee	9	13	8	21	12	10	10	20
Colorado	3	3	3	6	4	2	4	6
Missouri	2	2	0	2	2	1	1	2
Oregon	0	0	1	1	0	0	1	1
Washington	0	0	1	1	0	0	1	1
California	0	0	0	0	0	0	0	0
Maryland	3	4	1	5	4	2	3	5
New Jersey	3	5	6	11	3	2	7	9
Wisconsin	5	6	1	7	4	4	3	7
Minnesota	1	1	0	1	1	1	0	1
Indiana	5	7	0	7	6	3	6	9
Michigan	7	11	4	15	11	9	7	16
West Virginia	3	3	1	4	1	1	3	4
Kentucky	3	2	6	8	3	2	6	8
Georgia	1	0	4	4	0	1	3	4
Texas	0	0	4	4	0	0	4	4
Connecticut	3	2	1	3	2	3	0	3
Massachusetts	1	2	0	2	1	1	1	2
Total	258	338	131	469	293	206	267	473

The accompanying diagram (fig. 2) illustrates the course of the manufacture of pig iron, by months, in 1907, 1908, 1909, and 1910. The sudden decline in production of pig iron at the close of October, 1907, the low production during the first half of 1908, the slow recovery of activity in the last half of 1908, the hesitating conditions early in 1909, the steady and rapid increase in production during the last part of that year, culminating in December with a record production of more than 2,682,000 tons, and finally the gradual, almost uninterrupted decline throughout the year 1910, are all strikingly displayed.

PRODUCTION OF PIG IRON BY GRADES.

The following table shows the production of the principal grades of pig iron from 1906 to 1910, inclusive:

Production of pig iron in the United States, 1906–1910, by grades, in long tons.

Grade.	1906.	1907.	1908.	1909.	1910.
Bessemer and low phosphorus	13,840,518	13,231,620	7,216,976	10,557,370	11,245,642
Basic (mineral fuel)	5,018,674	5,375,219	4,010,144	8,250,225	9,084,608
Forge pig iron	597,420	683,167	457,164	725,624	564,157
Foundry and ferrosilicon	4,773,011	5,151,209	3,637,622	5,322,415	5,260,447
Malleable Bessemer	699,701	920,290	414,957	658,048	843,123
Spiegeleisen	244,980	283,430	111,376	142,831	153,055
Ferromanganese	55,520	55,918	40,642	82,209	71,376
White, mottled, direct castings, etc	77,367	80,508	47,137	56,749	81,159
Total	25,307,191	25,781,361	15,936,018	25,795,471	27,303,567

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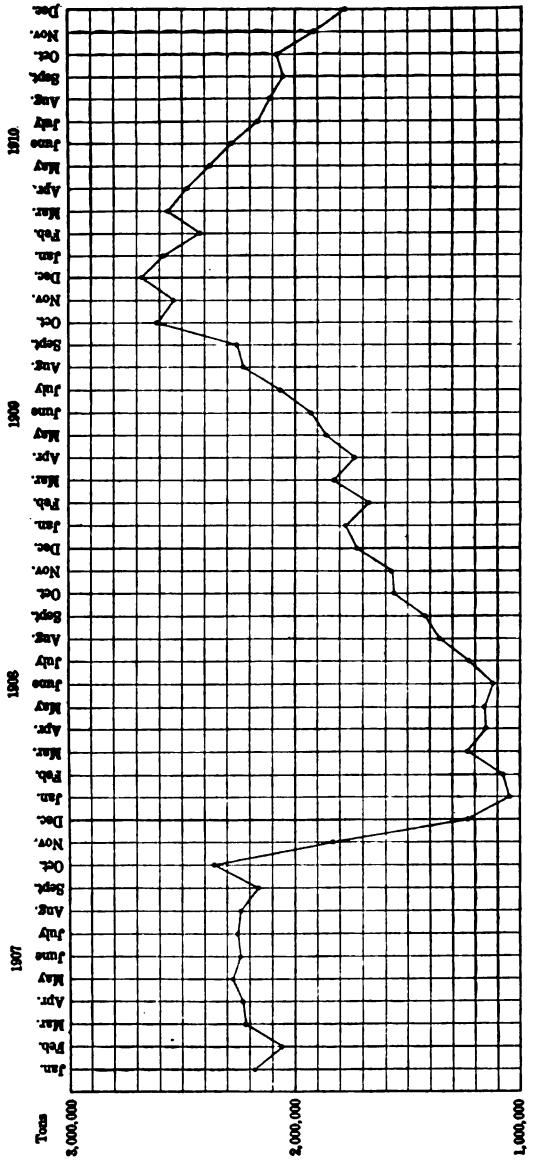

FIGURE 2.—Curve showing daily average production of pig iron in the United States in 1907, 1908, 1909, and 1910, by months.

[Tonnage by months according to the Iron Trade Review.

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PRODUCTION OF PIG IRON ACCORDING TO FUEL USED.

In the following table is given the production of pig iron according to the fuel used, from 1906 to 1910, inclusive:

Production of pig iron according to fuel used, 1906–1910, in long tons.

Fuel used.	1906.	1907.	1908.	1909.	1910.
Bituminous, chiefly coke	23,312,498	23,972,410	15,331,863	24,721,037	26,257,978
Anthracite and coke	1,535,614	1,335,286	353,315	682,383	628,579
Anthracite alone	25,072	36,268	1,694	16,048	20,503
Charcoal	433,007	437,397	249,146	376,003	396,507
Total	25,307,191	25,781,361	15,936,018	25,796,471	27,303,567

TOTAL PRODUCTION OF PIG IRON.

The following table shows the production of pig iron in the United States as far as has been recorded. The statistics for 1854 and all succeeding years were collected by the American Iron and Steel Association; those for 1810, 1840, and 1850 are census figures; those for the other years are largely estimates by early statisticans.

Production of pig iron in the United States, 1810–1910, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1810	53,908	1863	846,075	1887	6,417,148
1820	20,000	1864	1,014,282	1888	6,489,738
1828	130,000	1865	831,770	1889	7,603,642
1829	142,000	1866	1,205,663	1890	9,202,703
1830	165,000	1867	1,305,023	1891	8,279,870
1831	191,000	1868	1,431,250	1892	9,157,000
1832	200,000	1869	1,711,287	1893	7,124,502
1840	286,903	1870	1,665,179	1894	6,657,388
1842	215,000	1871	1,706,793	1895	9,446,308
1846	765,000	1872	2,548,713	1896	8,623,127
1847	800,000	1873	2,560,963	1897	9,652,680
1848	800,000	1874	2,401,262	1898	11,773,934
1849	650,000	1875	2,023,733	1899	13,620,703
1850	563,755	1876	1,868,961	1900	13,789,242
1852	500,000	1877	2,066,594	1901	15,878,354
1854	657,337	1878	2,301,215	1902	17,821,307
1855	700,159	1879	2,741,853	1903	18,009,252
1856	788,515	1880	3,835,191	1904	16,497,033
1857	712,640	1881	4,144,254	1905	22,992,380
1858	629,548	1882	4,623,323	1906	25,307,191
1859	750,560	1883	4,595,510	1907	25,781,361
1860	821,223	1884	4,097,868	1908	15,936,018
1861	653,164	1885	4,044,526	1909	25,796,471
1862	703,270	1886	5,683,329	1910	27,303,567

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PRICES OF PIG IRON.

In the following table are given the average monthly prices of the principal kinds of pig iron for 1909 and 1910:

Average monthly prices per ton of pig iron, 1909 and 1910, by months and kinds.

Month.	1909.			1910.		
	Gray forge pig iron at Pittsburgh.	Bessemer pig iron at Pittsburgh.	Basic pig iron at Philadelphia.	Gray forge pig iron at Pittsburgh.	Bessemer pig iron at Pittsburgh.	Basic pig iron at Philadelphia.
January	$15.40	$17.34	$16.75	$17.40	$19.90	$18.75
February	15.09	16.77	16.56	17.02	19.34	18.56
March	14.65	16.34	15.60	16.15	18.60	18.25
April	14.40	15.80	15.00	16.09	18.34	17.56
May	14.40	15.84	15.13	15.90	17.52	16.69
June	14.77	16.02	15.50	15.20	16.62	16.10
July	14.85	16.40	15.88	14.52	16.40	15.68
August	15.21	17.02	17.06	14.30	16.09	15.12
September	16.15	18.05	18.13	14.15	15.90	15.00
October	17.02	19.52	18.38	14.15	15.90	15.00
November	17.27	19.90	18.75	14.09	15.80	14.75
December	17.40	19.90	18.75	13.90	15.90	14.75

PRODUCTION OF STEEL BY STATES AND KINDS.

The following table shows the production of Bessemer steel ingots and castings in the leading States from 1906 to 1910, inclusive:

Production of Bessemer ingots and castings, 1906–1910, by States, in long tons.

State.	1906.	1907.	1908.	1909.	1910.
Pennsylvania	4,827,725	4,351,841	2,106,382	2,845,602	2,975,750
Ohio	3,769,913	3,636,679	1,955,446	3,466,077	3,314,053
Illinois	1,684,772	1,723,073	1,237,747	1,632,444	1,693,053
Other States	1,993,420	1,955,956	817,180	1,386,660	1,429,916
Total	12,275,830	11,667,549	6,116,755	9,330,783	9,412,772

In the following table is given the production of open-hearth steel ingots and castings in the leading States from 1906 to 1910, inclusive:

Production of open-hearth steel ingots and castings, 1906–1910, by States, in long tons.

State.	1906.	1907.	1908.	1909.	1910.
New England	251,047	239,797	158,417	257,392	223,158
New York and New Jersey	553,186	706,019	350,348	618,117	713,245
Pennsylvania	7,718,213	7,866,353	5,322,229	9,400,287	10,153,816
Ohio	818,683	819,642	525,171	1,424,452	1,733,409
Indiana	163,090	181,662	167,299	783,957	1,307,129
Illinois	884,472	1,013,251	493,104	1,052,572	995,011
Other States	591,722	721,012	830,161	957,159	1,378,741
Total	10,980,413	11,549,736	7,836,729	14,493,936	16,504,509

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The following table gives the production, by States, of basic and acid open-hearth steel ingots and castings in 1910:

Production of basic and acid open-hearth steel ingots and castings in 1910, by States, in long tons.

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	179,422	43,736	223,158
New York and New Jersey	636,896	76,349	713,245
Pennsylvania	9,270,722	883,094	10,153,816
Ohio	1,636,971	96,438	1,733,409
Indiana	1,278,734	28,395	1,307,129
Illinois	983,895	11,116	995,011
Other States	1,305,689	73,052	1,378,741
Total	15,292,329	1,212,180	16,504,509

The following table gives the production of all kinds of steel ingots and castings in 1909 and 1910:

Production of all kinds of steel ingots and castings in 1909 and 1910, by States, in long tons.

State.	1909.				1910.			
	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.
Massachusetts, Rhode Island, and Connecticut [a]	1,174	257,392	3,562	262,128	2,592	223,158	23,751	249,501
New York and New Jersey	602,046	618,117	34,930	1,255,093	740,529	713,245	34,856	1,488,630
Pennsylvania	2,845,602	9,400,287	63,900	12,309,789	2,975,750	10,153,816	77,973	13,207,539
Delaware, Maryland, District of Columbia, Virginia, West Virginia, Kentucky, Georgia, Alabama, Louisiana, and Texas	751,921	512,650	70	1,264,641	589,949	897,219	.....	1,487,168
Ohio	3,466,077	1,424,452	2,145	4,892,674	3,314,052	1,733,409	3,146	5,050,608
Indiana and Illinois	1,632,444	1,836,529	19,704	3,488,677	1,693,053	2,302,140	31,247	4,026,440
Other States	31,519	444,509	5,991	482,019	96,846	481,522	6,665	585,033
Total	9,330,783	14,493,936	130,302	23,955,021	9,412,772	16,504,509	177,638	26,094,919

[a] Figures for 1910 include Maine.

PRODUCTION OF ELECTRIC AND MISCELLANEOUS STEEL.

According to the statistics of the American Iron Trade for 1910, included in the total production of steel in 1910 there were 55,335 tons produced by various minor processes, including the electric process, as compared with 22,947 tons in 1909, an increase of 32,388 tons. Included in this total of 55,335 tons of steel, 52,141 tons of ingots and castings were made with electricity by 7 plants in Massachusetts, New York, Pennsylvania, Indiana, and Illinois, as compared with 13,762 tons made by 4 plants in 1909 in New York, Pennsylvania, and Illinois. In 1910 about 50,821 tons were ingots and about 1,320 tons were castings, and in 1909 13,456 tons were ingots and 306 tons were castings. Practically all the electric steel

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was refined from metal taken from Bessemer converters and from open-hearth furnaces. On December 31, 1910, one additional plant for the manufacture of steel by electricity was being built, and several plants were being projected. Work on one of the projected plants has since commenced.

TOTAL PRODUCTION OF STEEL.

The statistics of the production of various kinds of steel, so far as has been recorded, are given in the following table. The first steel produced in this country was probably made in Connecticut in 1728 by Samuel Higley and Joseph Dewey. Crucible steel was first successfully produced in the United States in 1832 at the works of William and John H. Garrard, at Cincinnati, Ohio. Bessemer steel was first made in this country in September, 1864, by William F. Durfee at an experimental plant at Wyandotte, Mich., and open-hearth steel in 1864 by the New Jersey Steel & Iron Co. at Trenton, N. J.

Production of steel in the United States, 1810–1910, in long tons.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1810	.....	.....	917		917
1860	.....	.....	11,838		11,838
1863	.....	.....	8,075		8,075
1864	.....	.....	9,258		9,258
1865	.....	.....	13,627		13,627
1866	.....	.....	16,940		16,940
1867	2,679	.....	16,964		19,643
1868	7,589	.....	19,197		26,786
1869	10,714	893	19,643		31,250
1870	37,500	1,339	29,911		68,750
1871	40,179	1,785	31,250		73,214
1872	107,239	2,679	26,125	6,911	142,954
1873	152,368	3,125	31,059	12,244	198,796
1874	171,369	6,250	32,436	5,672	215,727
1875	335,283	8,080	35,180	11,256	389,799
1876	469,639	19,187	35,163	9,202	533,191
1877	500,524	22,349	36,098	10,647	569,618
1878	653,773	32,255	38,309	7,640	731,977
1879	829,439	50,259	50,696	4,879	935,273
1880	1,074,262	100,851	64,664	7,558	1,247,335
1881	1,374,247	131,202	80,145	2,720	1,588,314
1882	1,514,637	143,341	75,973	2,691	1,736,692
1883	1,477,345	119,356	71,835	4,999	1,673,535
1884	1,375,531	117,515	53,270	4,563	1,550,879
1885	1,519,430	133,376	57,599	1,515	1,711,920
1886	2,269,190	218,973	71,973	2,367	2,562,503
1887	2,936,033	322,069	75,375	5,594	3,339,071
1888	2,511,161	314,318	70,279	3,682	2,899,440
1889	2,930,204	374,543	75,865	5,120	3,385,732
1890	3,688,871	513,232	71,175	3,793	4,277,071
1891	3,247,417	579,753	72,586	4,484	3,904,240
1892	4,168,435	669,889	84,709	4,548	4,927,581
1893	3,215,686	737,890	63,613	2,806	4,019,995
1894	3,571,313	784,936	51,702	4,081	4,412,032
1895	4,909,128	1,137,182	67,666	858	6,114,834
1896	3,919,906	1,298,700	60,689	2,394	5,281,689
1897	5,475,315	1,608,671	69,959	3,012	7,156,957
1898	6,609,017	2,230,292	89,747	3,801	8,932,857
1899	7,586,354	2,947,316	101,213	4,974	10,639,857
1900	6,684,770	3,398,135	100,562	4,862	10,188,329
1901	8,713,302	4,656,309	98,513	5,471	13,473,595
1902	9,138,363	5,687,729	112,772	8,386	14,947,250
1903	8,592,829	5,829,911	102,434	9,804	14,534,978
1904	7,859,140	5,908,166	83,391	9,190	13,859,887
1905	10,941,375	8,971,376	102,233	8,963	20,023,947
1906	12,275,830	10,980,413	127,513	14,380	23,398,136
1907	11,667,549	11,549,736	131,234	14,075	23,362,594
1908	6,116,755	7,836,729	63,631	6,132	14,023,247
1909	9,330,783	14,493,936	107,355	22,947	23,955,021
1910	9,412,772	16,504,509	122,303	55,335	26,094,919

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[a] Numbers of folios containing important notes on iron ores are printed in italics.

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MANGANESE ORE.

By Ernest F. Burchard.

MANGANESE-ORE INDUSTRY.

PRODUCTION.

According to reports received by the United States Geological Survey, the manganese-ore industry showed slightly greater activity in 1910 than in 1909. Manganese ore was mined in 1910 in Arkansas and Virginia, the output in Virginia being of the greater importance. The table of total production shows that only in three years, 1886, 1887, and 1888, has the production of manganese ore exceeded 25,000 tons, and that during the last 10 years the industry has not been in a prosperous condition. In 1910 the quantity marketed amounted to 2,258 long tons, valued at $22,892, the price per ton averaging $10.14, as compared with 1,544 long tons, valued at $19,675, an average price per ton of $12.74, in 1909. In addition to the quantity shipped, a small tonnage was mined and remained in stock at the mines at the end of the year.

The greater part of the high-grade manganese ore mined in the United States is used in the manufacture of brick, glass, and chemicals. The importations of manganese ore greatly exceed the quantities mined in this country—a condition likely to continue so long as the principal sources of foreign supply are large and cheaply worked and ocean freights are low.

The following table shows the quantity, value, and average price per ton of the manganese ore produced in the several States in 1908, 1909, and 1910:

Production of manganese ore in the United States, 1908–1910, by States, in long tons.

State.	1908			1909			1910		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Arkansas	.....	.....	.....	.....	.....	.....	(a)	(a)	.....
California	.....	.....	.....	(a)	(a)	.....	.....	.....	.....
Tennessee	.....	.....	.....	(a)	(a)	.....	.....	.....	.....
Virginia	6,144	$62,779	$10.22	[b] 1,544	[b] $19,675	$12.74	[c] 2,258	[c] $22,892	$10.14
Total	6,144	62,779	10.22	1,544	19,675	12.74	2,258	22,892	10.14

[a] Included with Virginia.
[b] Includes production of California and Tennessee.
[c] Includes production of Arkansas.

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The following table shows the total production of manganese ore in the United States, by States, as compiled from previous volumes of Mineral Resources. The production prior to 1880 is only approximate, but probably did not exceed 50,000 long tons. The table shows Arkansas, Georgia, and Virginia as the principal producers. California as a fairly steady producer but only of small quantities, and the other States as producing small quantities of ore intermittently. The table also shows the periods of comparatively large production followed invariably by marked declines; but the present decline, which shows little indication of being followed by a large increase in production in the near future, is by far the most serious of all.

Production of manganese ore in the United States, 1838–1910, in long tons.

Year.	Alabama.	Arkansas.	California.	Georgia.	Indian Territory, Michigan, Missouri, Montana, and Nevada.	North Carolina.
1838–1879		410				
1866–1879				19,950		
1867–1879			5,500			
1880				1,800		
1881		100		1,200		
1882		175		1,000		
1883		400				
1884		800				
1885		1,483	200	2,580	(Nev.) 200	
1886	75	3,316	100	6,041	(Nev.) 80	14
1887		5,651		9,024		14
1888		4,312	1,500	5,568	(Mich.) 100	
1889		2,528	53	5,208	(Nev.) 15	47
1890		5,339	386	749	(Nev.) 100	14
1891		1,650	705	3,575	(Ind.T.) 206	
1892		6,708		826		
1893		2,020	400	724		
1894		1,984	278	1,277		
1895		2,991	525	3,856		
1896		3,421	284	4,085		2
1897		3,240	484	3,332	(Mich.) 87	
1898	22	2,662	541	6,689		
1899		356	115	3,089	(Mo.) 16	90
1900		145	131	3,447	(Mont.) 137	
1901	17	91	610	4,074	(Mo.) 28	
1902		82	846	3,500		
1903			16	500		
1904			60			
1905			1	150		
1906		62	1			
1907			100			
1908						
1909			(a)			
1910		(a)				
Total	114	49,876	12,836	92,244	869	181

a Included with Virginia.

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Production of manganese ore in the United States, 1858–1910, in long tons—Continued.

Year.	Pennsylvania, South Carolina, and South Dakota.	Tennessee.	Utah and Vermont.	Virginia.	West Virginia and other States.	Total.
1858–1879						410
1866–1879						19,950
1867–1879				18,000		23,500
1880				3,661	300	5,761
1881				3,295	300	4,895
1882				2,982	375	4,532
1883				5,355	[b] 400	6,155
1884				8,980	[b] 400	10,180
1885				18,745	50	23,258
1886		50		20,567		30,198
1887				19,835		34,524
1888	(Pa.) 22			17,646	[c] 50	29,198
1889	(S. C.) 124	30	(Vt.) 1,576	14,616		24,197
1890				12,699		[d] 19,287
1891	(S. Dak.) 19		(Vt.) 49	16,248		[d] 22,452
1892				6,079		13,613
1893		482		4,092		7,718
1894		922		1,797	(W. Va.) 100	6,308
1895	(Pa.) 460			1,715		9,547
1896	(Pa.) 265			2,018	(W. Va.) 18	10,088
1897	(Pa.) 354	11		3,650		11,106
1898		381		5,662		15,957
1899	(Pa.) 12	19		6,228	(W. Va.) 10	9,935
1900		30		7,881		11,771
1901		400	(Utah) 2,500	4,275		11,995
1902	(S. C.) 8			3,041		7,477
1903	(S. C.) 25		(Utah) 483	1,801		2,825
1904			(Utah) 82	3,054		3,146
1905		20		3,947		4,118
1906		30	(Utah) 800	6,028		6,921
1907	(S. C.) 800	100		4,604		5,604
1908				6,144		6,144
1909		[a]		[e] 1,544		1,544
1910				[f] 2,258		2,258
Total	2,089	2,475	5,440	238,447	1,998	406,569

[a] Included with Virginia.
[b] Georgia and North Carolina.
[c] Nevada, North Carolina, South Carolina, Tennessee, and Vermont.
[d] Colorado production of 1890 and 1891 published formerly as manganese is manganiferous ore and has been transferred to that table.
[e] Includes production of California and Tennessee.
[f] Includes production of Arkansas.

STOCK.

The following table shows the quantities of manganese ore reported to the Survey as on hand mined at the close of 1910 in the various States:

Stock of manganese ore on hand at the mines, December 31, 1910, by States, in long tons

Arkansas	100
California	116
Utah	20
Virginia	2,085
Total	2,321

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MANGANIFEROUS ORES.

The total production of manganiferous ores in the United States in 1910 amounted to 619,735 long tons, as compared with 843,689 tons in 1909, a decrease of 223,954 tons. The Lake Superior region produced over 90 per cent of the total, but the percentage of manganese in the Lake ore is low, running generally less than 6 per cent, and the ore was used simply as a source of high-manganese pig iron. Of the manganiferous silver ore from Colorado, 55,770 tons were reported as used for fluxing. The manganiferous iron ore mined near Batesville, Ark., amounting to 5,030 tons, was used as a flux in blast furnaces at St. Louis, Mo.

The following table gives the quantity, value, average price per ton, and manganese content of Colorado manganiferous ores used in the manufacture of spiegeleisen from 1907 to 1909, inclusive. No ore was reported from Colorado as having been used for this purpose in 1910:

Production of Colorado manganiferous silver ores used in the manufacture of ferromanganese and spiegeleisen, 1907–1909, in long tons.

Year.	Percentage of manganese.	Quantity.	Value.	Average price per ton.
1907	10–25	67,514	$153,328	$2.27
1908	22–26	15,973	39,468	2.47
1909	[a]	12,905	29,682	2.30
Total		96,392	222,478	2.31

The following table gives the quantity, value, average price per ton, and the manganese content of the ores used principally for fluxing purposes, 1907 to 1910, inclusive, in Arkansas and Colorado:

Production of manganiferous ores used principally for fluxing or other purposes in Colorado and Arkansas, 1907–1910, in long tons.

Year.	State.	Percentage of manganese.	Quantity.	Value.	Average price per ton.
1907	Colorado	8–26	32,197	[a] $97,879	$3.04
1908	Arkansas	14	4,066	9,149	2.25
	Colorado	6–22	35,581	83,959	2.36
1909	Arkansas	28	3,325	5,819	1.75
	Colorado		52,119	179,813	3.45
1910	Arkansas	20–25	5,030	9,700	1.93
	Colorado	5–26	55,770	176,448	3.16
Total			188,068	562,747	2.99

[a] Partly estimated.

The following table gives the total production of all kinds of manganiferous ores in the United States so far as records are available. The disposition of the western ores has been already mentioned. All the eastern ore was presumably used in the manufacture of iron-manganese alloys.

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Production of manganiferous ores in the United States, 1885–1910, in long tons.

Year.	Arkansas.	Colorado.[a]	Colorado.[b]	Lake Superior region.	Virginia.	Other States.	Total.
1885						(Mont.)[b] 4,263	4,263
1886			[c]60,000	257,000			317,000
1887			[c]60,000	210,000	1,025	[d]726	271,751
1888			[c]60,000	[c]01,036		[e]1,096	262,132
1889			64,987	81,359			146,346
1890		[e]6,397	51,840	61,863			120,100
1891		[f]964	79,511	132,511			212 986
1892		2,942	62,309	147,431	3,000		215,682
1893	160	5,766	55,962	110,648	1,188	(N. C.) 20	173,744
1894		7,022	31,687	198,466			237,175
1895		13,464	54,163	112,265			179,892
1896		9,072	138,079	329,640			476,791
1897		16,519	149,502	184,585		(Vt.) 1,200	351,806
1898		18,848	99,651	268,862		(Pa.) 100	387,461
1899		29,355	79,855	732,490			841,700
1900		43,308	188,509	334,274			566,086
1901		62,385	228,187	512,084		(N. C.) 20	802,676
1902		13,275	194,132	884,939	3,000		1,095,346
1903		14,856	179,205	566,335	2,802		763,698
1904	600	17,074	105,278	365,572			488,524
1905	3,321	45,837	81,738	720,098			850,994
1906	8,900	32,400	(*g*)	[h]1,000,000			[h]1,041,300
1907	4,133	67,514	32,197	314,316		(N. M.) 7,000	425,160
1908	4,066	15,973	35,581	467,140	274		523,034
1909	3,325	12,905	52,119	775,035	305		813,689
1910	5,030		55,770	558,634	301		619,735
Total	29,535	435,871	2,200,262	9,527,083	11,895	14,425	12,219,071

[a] Manganiferous silver ore used in the manufacture of spiegeleisen and ferromanganese.
[b] Manganiferous silver ore used for flux; mainly from Colorado, but in a few cases probably including other Western States.
[c] Contains some Montana ore.
[d] Georgia 195 tons, Maine 50 tons, and Vermont 481 tons.
[e] North Carolina, South Carolina, and Tennessee 96 tons, and Vermont 1,000 tons
[f] Published as manganese ore in previous volumes of Mineral Resources.
[g] Not recorded.
[h] Estimated.

MANGANIFEROUS ZINC RESIDUUM.

The material classed under this head is a residual product from certain zinc oxide works using New Jersey zinc ores. The crude ore consists of a mixture of franklinite, zincite, and willemite, the first being predominant. During roasting the bulk of the zinc is removed as zinc oxide, and the residuum consists of a mass of manganese and iron oxides. This residuum is used for the manufacture of spiegeleisen and ferromanganese. In 1910 the production of manganiferous zinc residuum amounted to 137,173 long tons, valued at $411,519, as compared with 141,264 long tons, valued at $423,792, in 1909. The following table shows the quantity, value, and average price per ton of manganiferous zinc residuum produced from 1905 to 1910, inclusive:

Production of manganiferous zinc residuum in the United States, 1905–1910, in long tons.

Year.	Quantity.	Value.	Average price per ton.
1905	90,289	$90,289	$1.00
1906	93,461	93,461	1.00
1907	93,413	280,239	3.00
1908	110,225	330,675	3.00
1909	141,264	423,792	3.00
1910	137,173	411,519	3.00
Total	665,825	1,629,975	2.45

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The following table gives the production of manganiferous zinc residuum in the United States so far as has been recorded:

Production of manganiferous residuum from zinc roasting in the United States, 1889–1910, in long tons.[1]

1889	43,648	1901	52,311
1890	48,560	1902	65,246
1891	38,228	1903	73,264
1892	31,859	1904	68,189
1893	37,512	1905	90,289
1894	26,981	1906	93,461
1895	43,249	1907	93,413
1896	44,935	1908	110,225
1897	33,924	1909	141,264
1898	48,502	1910	137,173
1899	65,010		
1900	87,110	Total	1,474,353

PRICES OF ORES.

UNITED STATES.

The prices of manganese ores used in the steel industry vary from $5 to $15 per long ton, according to the grade of the ore. They are governed by the following schedule of prices established by the Carnegie Steel Co.:[2]

Schedule of prices paid per ton of 2,240 pounds for domestic manganese ore delivered at Pittsburg or Bessemer, Pa., and South Chicago, Ill.

Prices are based on ores containing not more than 8 per cent silica or 0.20 per cent phosphorus, and are subject to deductions as follows: For each 1 per cent in excess of 8 per cent silica there shall be deduction of 15 cents per ton; fractions in proportion.

For each 0.02 per cent, or fraction thereof, in excess of 0.20 per cent phosphorus there shall be a deduction of 2 cents per unit of manganese per ton.

Percentage of metallic manganese in ore.	Price per unit in cents.	
	Manganese.	Iron.
Over 49	26	5
46 to 49	25	5
43 to 46	24	5
40 to 43	23	5

Ores containing less than 40 per cent manganese or more than 12 per cent silica or 0.225 per cent phosphorus are subject to acceptance or refusal at the buyer's option.

Settlements are based on analysis of sample dried at 212° F., the percentage of moisture in the sample as taken being deducted from the weight.

The manganese ores for oxidizing and coloring purposes are valued according to the quantity of manganese peroxide present, their consistency, etc., and prices range up to $35 per ton for the better grades of ore. Manganiferous ores used in iron and steel manufacture and for fluxing range in price from $2 per ton upward.

FOREIGN COUNTRIES.[3]

Because of the large quantities of high-grade manganese ore obtainable in Russia, India, and Brazil, the buyers' requirements have steadily

[1] The manufacture of spiegeleisen from manganiferous residuum was begun in 1870, but there is no record of the tonnage of raw material used prior to 1889.

[2] Prices of manganese ore: Eng. and Min. Jour., Mar. 5, 1910.

[3] Market value of manganese ores: Eng. and Min. Jour., Mar. 4, 1911, p. 465.

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advanced until now ore averaging from 50 to 60 per cent manganese is not at all uncommon. In the Zeitschrift für angewandte Chemie, November 25, 1910, A. Rzehulka discusses briefly the marketing of manganese ores.

In the last 10 years Russia has produced about 40 per cent of the total quantity of manganese ore mined in the world. Its annual production is about 550,000 long tons, of which about one-fifth comes from Nikopol, in southern Russia, and about four-fifths from the Caucasus. About one-fourth of the total production is consumed in Russia, and of this consumption about 74 per cent comes from Nikopol, so that nearly the entire output of the Caucasus is exported. The principal competitors of Russia in the world's market are India and Brazil; the largest consumer of manganese ore is the United States, followed by Germany and England. In the American market Russian ore has now almost disappeared, and in the other markets also the consumption of manganese ore mined elsewhere than in Russia is steadily growing. Consumption in England and Germany has increased markedly in recent years, with the result that exports from Russia to these two countries have nearly doubled; and yet, whereas up to 1907 about 46 per cent of the English imports and 72 per cent of the German imports came from Russia, in that year Russia provided only 24 per cent of the manganese ore consumed in England and only 50 per cent of that consumed in Germany.

Russian manganese ore is bought in Germany, on the basis of 50 per cent manganese, at 1.10 marks per unit, with 1 mark added or deducted for each 1 per cent above or below the basis; the sample is dried at 100° C. The maximum limit for phosphorus is 0.15 per cent, and for silica 9 per cent. The price for Russian ore in all European ports ranges from 0.65 to 1.30 marks per unit of manganese, with deductions of 35 to 40 pfennigs per ton for each per cent of silica over 9 per cent; deductions vary for excess of phosphorus above the allowable limit. With Turkish manganese ore, the basis is 45 per cent manganese, with not more than 0.03 per cent phosphorus, nor more than 10 per cent silica, and the price is about 95 pfennigs per unit, or somewhat higher for ore of better grade; deductions for silica and phosphorus are subjects of negotiation.

Japanese ore is sold at Hamburg on the following schedules, in marks per ton on the basis of content of manganese dioxide: 87 per cent and above, 115 marks per ton; 85–90 per cent (minimum 85), 95 marks per ton; 80 per cent, 85 marks per ton; 70–75 per cent, 75 marks per ton; 65–70 per cent, 50 marks per ton.

The Japanese ore averages from 44 to 56 per cent manganese, phosphorus is about 0.5 per cent, and silica 7 to 10 per cent. The ore goes by the name of Japanese brownstone, and brings a high price on account of its purity.

German manganese ore sells at the mine, on the basis of 50 per cent manganese dioxide, at about 20 marks per ton, equivalent to 40 pfennigs per unit of dioxide; for each unit of dioxide above or below 50 per cent, about 1 pfennig is added or deducted.

The annual production of manganese ore in the world is subject to wide fluctuations, as a result, partly, of political disturbances in the principal producing countries. It is also directly influenced by the condition of the iron industry, which consumes by far the largest part of the manganese ore produced in the world.

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The consumption of manganese ore in Germany is about 250,000 tons a year, of which only about 50,000 tons are produced in that country. The most convenient source of supply for the extra 200,000 tons is the Caucasus district, but on account of the political uneasiness in Russia it is becoming an interesting problem to arrange for future supplies obtainable with regularity.

IMPORTS.

The imports of manganese ore into the United States in 1910 amounted to 242,348 long tons, valued at $1,711,131, as compared with 212,765 tons, valued at $1,405,329, imported in 1909, an increase in quantity of 29,583 tons and in value of $305,802. The total imports for 1910 were exceeded only by those for the years 1900 and 1905. As is shown in the table, the principal exporting countries are Brazil and British India, with important quantities imported from Russia, France, and Germany.

The following tables, compiled from data furnished by the Bureau of Statistics, Department of Commerce and Labor, show the imports of manganese ore into the United States from different countries and by ports of entry for 1908, 1909, and 1910:

Imports of manganese ores into the United States, 1908–1910, by countries, in long tons.

Country.	1908		1909		1910	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Brazil	17,150	$163,561	35,600	$323,748	53,750	$544,353
Russia	250	4,599	14,486	95,658	33,120	269,717
British India	143,813	912,646	145,140	735,967	140,965	682,897
Cuba	1,469	13,489	2,960	11,800	2	26
Other East Indies	7	170	.....	.....	.....	.....
France	5,546	75,857	5,974	79,023	4,853	63,933
Netherlands	761	11,265	1,074	11,037	55	935
Japan	3,336	41,930	1,272	17,739	952	14,277
Germany	2,620	62,045	2,618	57,916	4,928	83,369
United Kingdom	2,973	59,092	1,385	40,525	2,330	35,718
Canada	73	1,245	766	9,234	15	704
Spain	.....	24	.....	.....	.....	.....
Belgium	202	4,214	1,505	22,617	1,378	15,202
All other countries	3	86	.....	.....	.....	.....
Total	178,203	1,350,223	212,765	1,405,329	242,348	1,711,131

Manganese ores imported into the United States, 1908–1910, by customs districts, in long tons.

Customs districts.	1908		1909		1910	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Philadelphia, Pa.	68,491	$504,094	62,717	$381,780	104,855	$679,974
Baltimore, Md	103,043	724,913	143,122	891,758	131,526	930,902
New York, N. Y	5,963	105,665	5,146	98,762	3,548	67,683
Boston, Mass.	5	280	52	1,041	1	82
New Orleans, La.	232	2,752	.....	.....	1,720	16,293
All others	469	12,519	1,728	32,038	698	16,247
Total	178,203	1,350,223	212,765	1,405,329	242,348	1,711,131

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The following table shows the total quantity of manganese ore imported into the United States, as far as has been recorded. The figures from 1868 to 1888 represent imports from Canada only; those from 1889 to the present time represent total imports.

Imports of manganese ore into the United States, 1868–1910, in long tons.

Year ending—	Quantity.	Year ending—	Quantity.
June 30—		Dec. 31—Continued.	
1868	1,017	1890	34,154
1869	488	1891	28,825
1870	1,402	1892	58,572
1871	1,056	1893	68,113
1872	1,206	1894	44,655
1873	838	1895	86,111
Dec. 31—		1896	31,489
1873	1,031	1897	119,961
1874	782	1898	114,885
1875	208	1899	188,349
1876	412	1900	256,252
1877	891	1901	165,722
1878	626	1902	235,576
1879	1,886	1903	146,056
1880	2,179	1904	108,519
1881	1,704	1905	257,033
1882	894	1906	221,260
1883	1,326	1907	209,021
1884	603	1908	178,203
1885	1,684	1909	212,765
1886	1,818	1910	242,348
1887	1,630		
1888	1,182	Total	[b] 3,037,013
1889 [a]	4,286		

[a] Figures prior to 1889 represent imports from Canada only, total importations from other countries for these years not being obtainable.
[b] This total duplicates the importation from Jan. 1 to June 30, 1878.

PRODUCTION IN PRINCIPAL PRODUCING COUNTRIES.

The following table gives the latest available statistics with regard to American and foreign production of manganese ore. The unit is the metric ton for all countries except the United States, whose production is given in long tons.

Production in principal producing countries of manganese ores, in long tons.

Country.	Year.	Quantity.	Country.	Year.	Quantity.
North America:			Europe—Continued.		
United States	1910	2,258	United Kingdom	1909	2,768
South America:			Russia	1907	987,724
Brazil [a]	1908	163,506	Spain	1908	16,678
Chile	1908	1	Sweden	1908	4,594
Europe:			Turkey	[b] 1908	14,123
Austria	1909	17,717	Norway	1904	22
Belgium	1909	6,171	Asia:		
Bosnia and Herzegovina	1908	6,791	India	1908	674,315
Hungary	1908	10,410	Japan	1908	10,955
France	1909	9,252	Java	1908	1,181
German Empire	1909	75,787	Oceania:		
Greece	1908	10,581	Queensland	1908	1,381
Italy	1909	4,626			

[a] Exports. [b] Year ending March, 1908.

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FERROMANGANESE AND SPIEGELEISEN.

PRODUCTION.

The total production of ferromanganese and spiegeleisen in the United States in 1910 was 224,431 long tons, of which 71,376 tons were ferromanganese and 153,055 tons were spiegeleisen. As compared with the production in 1909 of ferromanganese, which was 82,209 tons, and of spiegeleisen, which was 142,831 tons, the production of 1910 represents a loss of 10,833 tons and a gain of 10,224 tons, respectively, or a loss of about 0.3 per cent from the total for 1909. The output of these materials in 1909 was from Pennsylvania and Illinois.

Production of spiegeleisen and ferromanganese in the United States, 1872–1910, in long tons.

1872	4,072	1893	81,118
1873	3,930	1894	120,180
1874	4,070	1895	171,724
1875	6,993	1896	131,940
1876	5,907	1897	173,695
1877	7,897	1898	213,769
1878	9,530	1899	219,768
1879	12,438	1900	255,977
1880	17,503	1901	291,461
1881	18,827	1902	212,934
1882	19,610	1903	192,661
1883	21,941	1904	219,446
1884	30,262	1905	289,983
1885	30,956	1906	300,500
1886	42,841	1907	339,348
1887	42,498	1908	152,018
1888	48,901	1909	225,040
1889	76,628	1910	224,431
1890	133,180		
1891	127,766	Total	4,660,874
1892	179,131		

PRICES.

The prices of iron-manganese alloys vary with the content of these metals. However, as the alloys are generally made with a fairly definite composition, the prices vary only within small limits.

The following table shows the average range of prices for various iron-manganese alloys during 1910:

Prices per long ton of iron-manganese alloys during 1910.

Alloy.	Approximate percentage of manganese and silicon.	Price.
Ferromanganese [a]	75–80 Mn	$39.45–$45.95
Spiegeleisen [a]	15–20 Mn	23.00– 28.50
Silicomanganese	70–75 Mn, 20–25 Si	.....
Silicospiegel [a]	15–20 Mn, 10–12 Si	25.00– 29.00

[a] Compiled from weekly tables in the Industrial World, Pittsburg.

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IMPORTS.

Important and steadily increasing quantities of iron-manganese alloys are imported into the United States annually. The following table gives the quantity and value of ferromanganese and spiegeleisen imported into the United States from 1903 to 1910, inclusive:

Ferromanganese and spiegeleisen imported and entered for consumption, 1903–1910, in long tons.

Year.	Ferromanganese.		Spiegeleisen.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	41,519	$1,699,666	122,015	$2,709,317	163,534	$4,408,983
1904	21,813	707,037	4,623	132,461	26,436	839,498
1905	52,841	1,884,651	55,457	1,336,104	108,298	3,220,755
1906	84,359	4,953,644	103,268	2,942,940	187,627	7,896,584
1907	87,400	5,354,656	48,994	1,399,381	136,394	6,754,037
1908	44,624	1,860,664	4,579	125,054	49,203	1,985,718
1909	88,934	3,396,881	16,921	356,447	105,855	3,752,828
1910	114,227	4,341,071	25,383	489,049	139,610	4,830,120

SOURCES OF MANGANESE.[1]

The principal manganese minerals forming ores of manganese are the following:

Principal manganese minerals.

Mineral.	Composition.	Percentage of manganese.
Pollanite	MnO_2	63.2
Pyrolusite	$MnO_2 n H_2O$	60–63
Psilomelane	$MnO_2.(MnKBa)O.n H_2O$	45–60
Wad	Hydrous impure mixture of manganese oxides	Variable.
Manganite	$Mn_2O_3.H_2O$	62.4
Braunite	$3Mn_2O_3.MnO.SiO_2$	69
Franklinite	$(FeZnMn)O.(FeMn)_2O_3$	Variable.
Rhodochrosite	$MnO.CO_2$	47.56
Rhodonite (manganese pyroxene)	$MnO.SiO_2$	41.9
Tephroite (manganese olivine)	$2MnO.SiO_2$	54.3
Spessartite (manganese garnet)	$3MnO.Al_2O_3.3SiO_2$	33.3

These minerals occurring separately or combined among themselves or with other minerals form four different classes of materials from which manganese is obtained commercially: (1) Manganese ores; (2) manganiferous iron ores; (3) manganiferous silver ores; and (4) manganiferous zinc residuum. Manganese ores consist of various mixtures of manganese oxides, sometimes containing admixtures of manganese carbonate.

Manganese ores.—Deposits of manganese ore occur in many parts of the United States, but are most abundant in the Appalachian and Piedmont regions, in the southern Mississippi Valley, and on the Pacific coast. Small deposits occur in the New England, Rocky

[1] Notes by E. C. Harder, of the U. S. Geological Survey.

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Mountain, and Great Basin regions. The principal producing districts up to the present have been the James River-Staunton River and the Blue Ridge regions in Virginia; the Cave Spring and Carters ville districts in Georgia; the Batesville district in Arkansas; and the Livermore-Tesla district in California. Of minor importance are the New River region in Virginia, the northeastern Tennessee region, the McCormick region in South Carolina, and the Little Grande district in Utah. At present mining and shipping is confined in Virginia to the Blue Ridge and James River-Staunton River regions.

Manganiferous iron ores.—Manganiferous iron ores consist of mixtures of manganese and iron oxides. Manganiferous iron ores occur in the United States chiefly in the New England, the Appalachian, and the Lake Superior regions, and minor deposits are found in the southern Mississippi Valley and in the Rocky Mountain region. High-grade manganiferous iron ore used for its manganese content occurs in the Appalachian region. Other manganiferous iron ores are produced in the Appalachian and the Lake Superior districts which are so low in manganese that they are classed as iron ores. In the blast furnace they yield a "high-manganese" pig iron, which is used for special purposes.

Manganiferous silver ores.—Manganiferous silver ores consist of mixtures of manganese and iron oxides with small quantities of silver sulphide and lead carbonate. As a rule, the iron content exceeds the manganese content, but locally the iron is altogether absent.

Manganiferous silver ores are divided into three classes, according to their uses. (1) The greater portion of the manganiferous silver ores are used for their silver and lead content. Manganese and iron content often insures those ores a higher price because of their fluxing value. (2) A second class of manganiferous silver ore is too low in silver and lead to be used as a source for these metals, but is sufficiently high in manganese and iron to be used for the manufacture of ferromanganese and spiegeleisen, as is the case with the high-grade manganiferous iron ores already mentioned. (3) There is a third class of manganiferous silver ore too low in silver and lead to be used primarily for these metals and too low in iron and manganese to be used for the manufacture of iron-manganese alloys. This ore is sold to the smelters as flux, the iron and manganese becoming waste products, while the silver and lead content is recovered during the smelting.

Manganiferous silver ores occur in the Rocky Mountain and Great Basin regions, the principal producing locality being Leadville, Colo. Some of the Leadville ores are used in the manufacture of spiegeleisen. All the other localities produce these ores for fluxing only.

Manganiferous zinc residuum.—Manganiferous zinc residuum is an artificial furnace product consisting of mixtures of manganese and iron oxides in a matrix of slag. Manganiferous zinc residuum is obtained from zinc volatilizing and oxidizing furnaces using New Jersey zinc ores. The residuum consists largely of iron and manganese oxides, the zinc having been removed by volatilization and collected as zinc oxide. The crude ores consist of franklinite, zincite, and willemite, and are obtained only from the Franklin Furnace district, New Jersey. Small quantities of zinc residuum are used annually in the manufacture of spiegeleisen.

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USES OF MANGANESE.[1]

The principal use of manganese ores is in the manufacture of iron-manganese alloys such as spiegeleisen, ferromanganese, silverspiegel, and silicomanganese. The first two of these contain principally iron and manganese; the last two contain considerable silicon in addition. Ferromanganese and spiegeleisen are used in steel manufacture as reducers of iron oxide during the final melting, as recarburizers, and in the manufacture of special steels alone or in combination with chromium, nickel, tungsten, and other steel-hardening metals. Manganese is also used in the formation of alloys with copper, aluminum, zinc, tin, and other metals.

Manganese ores or manganiferous iron ores are used to a slight extent as fluxes in the reduction of silver, lead, and copper ores.

Manganese peroxide is used as an oxidizer in the manufacture of chlorine, bromine, and oxygen, and of potassium ferromanganate; as a drier in paints and varnishes; as a decolorizer of glass; and in the manufacture of the dry and the Leclanche cells. As a coloring material, manganese is used in coloring glass, bricks, and pottery. Several manganese salts are used in drying cloth and as paints.

More complete discussions of the sources, uses, and occurrence of manganese ore were published in the statistical reports on manganese ore for 1907 and 1908,[2] and in a general report on manganese recently published by the Survey.[3]

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[1] Notes by E. C. Harder, of the U. S. Geological Survey.

[2] Harder, E. C., Manganese ores: Mineral Resources U. S. for 1907, U. S. Geol. Survey, 1908; Mineral Resources U. S. for 1908, U. S. Geol. Survey, 1909.

[3] Harder, E. C., Manganese deposits of the United States, with sections on foreign deposits, chemistry, and uses: Bull. U. S. Geol. Survey No. 427, 1910.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE UNITED STATES IN 1910.

PREFATORY NOTE.

In the following pages will be found reports on the metallurgical production of gold, silver, copper, lead, and zinc in the United States in 1910; then follow accounts of the production of gold, silver, copper, lead, and zinc by mines—all of these being parts of the annual report on the gold, silver, copper, lead, and zinc industries in the United States.

The portion of this annual report dealing with mine production has been divided, for the sake of convenience and for distribution in advance, into three sections corresponding to broad geographic divisions of the country. As a part of a comprehensive report devoted to the whole country, each section has a certain system and uniformity of treatment imposed upon it which might not in all cases be necessitated by the local conditions of the particular region with which it deals. Accordingly, the general scope of treatment, the arrangement, the tables, and the units of measurement conform as far as possible with those of the sections devoted to other parts of the country as being best adapted to expression of the features of the mining industry of the entire United States. The short ton of 2,000 pounds is used throughout. The price per unit of the production (gold excepted, which is fixed by law) is based upon the average for the year 1910 of daily New York prices for the metals, as follows:

Gold	per fine ounce (troy)..	$20.671834625323
Silver	do....	.54
Copper	per pound..	.127
Lead	do....	.044
Zinc	do....	.054

It is to be understood, of course, that the full market values are not received for the metals in ore and intermediate products sold to the custom plants.

The full report on the industries of gold, silver, copper, lead, and zinc embraces the following sections:

Gold and silver (general report).
Copper (smelter production).
Lead (smelter production).
Zinc (smelter production).
Gold, silver, copper, lead, and zinc in the Western States (mine production).
Silver, copper, lead, and zinc in the Central States (mine production).
Gold, silver, copper, lead, and zinc in the Eastern States (mine production).

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The first four sections give summary reviews of the respective industries for the United States as a whole, together with general statistics based on returns from mints, refineries, and smelters, and additional data from the mines report; the last three sections also give reviews of the industries with special reference to States and to the details of mining districts and the production of each metal, but based on reports made directly to the Survey from the mines.

Each of these sections is published as a separate pamphlet and may be obtained by addressing a request to the Director of the United States Geological Survey, Washington, D. C.

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GOLD AND SILVER.

By H. D. McCaskey.[1]

ACKNOWLEDGMENTS.

To the thousands of men engaged in the mining and metallurgical industries, to merchants, bankers, and transportation officials of the United States and Alaska, to the Bureau of the Mint, the Post Office Department, the Bureau of Statistics of the Department of Commerce and Labor, and to other officials, public and private, who have cooperated with the United States Geological Survey in furnishing information on the production of gold and silver, acknowledgment is most gratefully made. This cooperation is each year more freely given, and the results are correspondingly of increased value, not only to those directly concerned, but also to the public at large.

PRODUCTION OF GOLD AND SILVER IN 1910.

GENERAL STATEMENT.

The production of gold and silver in the United States from domestic ores in 1910 is shown in the following table, in distribution by States and Territories:

Approximate distribution by producing States and Territories of the product of gold and silver in the United States for the calendar year 1910, in fine ounces.[a]

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
Alabama	1,592	$32,900	300	$200
Alaska	787,148	16,271,800	153,900	83,100
Arizona	165,114	3,413,200	2,655,700	1,434,100
California	988,853	20,441,400	1,791,600	967,500
Colorado	992,969	20,526,500	8,523,000	4,602,400
Georgia	1,161	24,000	300	200
Idaho	50,112	1,035,900	7,027,000	3,794,600
Illinois	.....	.....	2,000	1,100
Kentucky	.....	.....	100	100
Michigan	.....	.....	262,200	141,600
Missouri	.....	.....	32,200	17,400
Montana	179,975	3,720,400	12,282,900	6,632,700
Nevada	913,015	18,873,700	12,366,000	6,677,600
New Hampshire and Pennsylvania	285	5,900	700	400
New Mexico	23,085	477,200	779,000	420,600
North Carolina	3,120	64,500	8,300	4,500
Oregon	32,963	681,400	43,800	23,600
Philippines Islands	7,469	154,400	1,800	1,000
Porto Rico	48	1,000	.....	.....
South Carolina	1,829	37,800	.....	.....
South Dakota	260,267	5,380,200	120,600	65,100
Tennessee	135	2,800	69,800	37,700
Texas	19	400	364,400	196,800
Utah	208,627	4,312,700	10,445,900	5,640,800
Virginia	44	900	200	100
Washington	38,990	806,000	204,900	110,600
Wyoming	198	4,100	1,300	700
Total	4,657,018	96,269,100	57,137,900	30,854,500

[a] Gold value, $20.671834625323 per fine ounce. Average commercial silver value in 1910, 54 cents per fine ounce.

[1] Valuable aid has been rendered by J. P. Dunlop in the preparation of most of the tables of this report and in the verification of all the figures.

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The figures in this table are also those of the Director of the Mint. They result from cooperation of the Bureau of the Mint and the United States Geological Survey and are agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

The totals of this table are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by information collected by the United States Geological Survey direct from the producing mines and tabulated for the mine reports later discussed. The data giving the total production, and in part the distribution, are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ores, matte, etc., exported for reduction. The last item is of small relative importance.

Gains and losses in the production of gold and silver in the several States and Territories, as compared with the output of 1909, are shown in the following table:

Increase (+) or decrease (−) in production of precious metals in the United States in 1910, by States and Territories, in fine ounces.

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
Alabama	+ 179	+ $3,700	+ 100	+ $100
Alaska	−196,780	−4,067,800	− 44,700	− 20,200
Arizona	+ 38,043	+ 786,400	+ 132,100	+ 121,800
California	− 12,684	− 262,200	− 513,300	− 231,000
Colorado	− 63,860	−1,320,100	− 323,300	+ 2,300
Georgia	− 938	− 19,400	+ 100	+ 100
Idaho	− 14,914	− 308,300	+ 271,100	+ 281,500
Illinois	.....	.....	+ 1,100	+ 600
Kentucky	.....	.....	+ 100	+ 100
Michigan	.....	.....	+ 44,600	+ 28,500
Missouri	− 10	− 200	+ 17,000	+ 9,500
Montana	− 1,436	− 29,700	+ 248,400	+ 374,800
Nevada	+120,333	+2,487,500	+2,246,800	+1,415,600
New Hampshire and Pennsylvania	− 15	− 300	− 2,300	− 1,200
New Mexico	+ 10,856	+ 224,400	+ 454,800	+ 252,000
North Carolina	+ 1,601	+ 33,100	+ 7,900	+ 4,300
Oregon	− 7,140	− 147,600	− 25,800	− 12,600
Philippine Islands	− 4,509	− 93,200	− 1,200	− 600
Porto Rico	+ 19	+ 400	.....	.....
South Carolina	+ 1,471	+ 30,400	.....	.....
South Dakota	− 57,731	−1,193,400	− 75,700	− 37,000
Tennessee	− 73	− 1,500	+ 4,500	+ 3,800
Texas	.....	.....	− 43,700	− 15,400
Utah	+ 4,809	+ 99,400	− 105,200	+ 154,200
Virginia	− 150	− 3,100	− 6,200	− 3,200
Washington	+ 18,237	+ 377,000	+ 129,700	+ 71,500
Wyoming	+ 9	+ 200	− 500	− 200
Total net increase (+) or decrease (−), 1910	−164,683	−3,404,300	+2,416,400	+2,399,300

In addition to the production of 2,913,875 ounces of gold and 55,691,741 ounces of silver from domestic sources in 1910, the smelters and refineries produced as refined bullion from foreign ore, matte, and unrefined bullion 934,730 fine ounces of gold, valued at $19,322,584, and 68,957,106 fine ounces of silver, valued at $37,236,837, a total

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output of refineries in the United States in 1910 of 3,848,605 fine ounces of gold and 124,648,847 ounces of silver. Of the foreign gold about $7,800,000 is credited to Mexico, and about $8,300,000 to Canada. Over $700,000 came from Salvador, over $300,000 from Spain (mainly from pyrites), over $200,000 from Peru and Honduras, and over $100,000 from France and Bolivia. Of the foreign silver about 41,000,000 ounces came from Mexico, about 19,000,000 ounces from Canada (largely from Cobalt), over 3,000,000 ounces came from Bolivia, over 1,500,000 ounces from Peru, and nearly 1,000,000 ounces from Spain, mainly from pyrites.

Gold.—The total production of gold in the United States in 1910 was 4,657,018 fine ounces, valued at $96,269,100—a decrease, compared with the output of 1909, of 164,683 ounces in quantity and of $3,404,300 in value. Next to the record production of 1909, however, it was the largest output of gold in the history of the country.

As in 1909 the production of gold was the contribution of 22 States and Territories and the Philippine Islands and Porto Rico. Of these 24 geographic subdivisions there was increased output from 11 and decreased production from 13 in 1910, as in 1909. The greatest gains were as follows: Nevada, $2,487,500; Arizona, $786,400; Washington, $377,000; New Mexico, $224,400; and Utah, $99,400. The heaviest decreases were: Alaska, $4,067,800; Colorado, $1,320,100; South Dakota, $1,193,400; Idaho, $308,300; California, $262,200; Oregon, $147,600; and the Philippines, $93,200. In no other State did the production increase or decrease as much as $50,000.

The gold-mining industry was fairly active in 1910, as in 1909, notwithstanding the decreases noted in output. In Alaska the decline in gold output was chiefly from the Fairbanks district, in the Yukon basin, where exhaustion of the high-grade gravels has been expected. In Colorado the decrease was due in part to further delay in working the deeper levels at Cripple Creek, pending drainage by the Roosevelt Tunnel, but it was also due to working out the ore bodies of older properties in other districts; and in South Dakota decreased production was due mainly to labor troubles at the beginning of the year. In both Alaska and Colorado prospecting and development have been active and in South Dakota normal conditions are expected to bring about increased production for 1911. In Nevada the great Goldfield and Tonopah camps, although producing from few mines, made remarkable outputs, and mining development was generally active elsewhere in the State. In Arizona the Gold Road and Tom Reed mines of Mohave County were again notable producers, and in New Mexico and Washington gold production increased. In California dredging and deep mining continued important. The outlook for 1911 is for increased domestic production of gold. In the gold production of the world in 1910 the Transvaal was first, with an output of approximately $155,750,000, followed by the United States as second in rank with $96,269,100, by Australasia with $65,325,000, by Russia with $40,000,000, and by Mexico with $24,000,000.

Silver.—The output of silver from domestic ores in 1910 was 57,137,900 fine ounces, valued at $30,854,500. This was an increase over the production of 1909 of 2,416,400 ounces in quantity and, partly owing to the increased price for silver, of $2,399,300 in value.

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Twenty-four States and Territories and the Philippine Islands contributed to the production of silver in 1910. Of these there was increased output in 14 and decreased production in 11. The main increase, 2,246,800 ounces, was in Nevada; but there were also increases of 454,800 ounces in New Mexico, of 271,100 ounces in Idaho, of 248,400 ounces in Montana, of 132,100 ounces in Arizona, and of 129,700 ounces in Washington. The largest reported decreases were as follows: In California, 513,300 ounces; in Utah, 105,200 ounces; and in South Dakota, 75,700 ounces. In no other States or Territories was the increase or decrease as much as 50,000 ounces. The silver production continues to be mainly from dry or siliceous gold-silver ores, copper ores, and lead ores, in the order named; but the increased output of 1910 was chiefly from the first-named class and to a smaller extent from zinc ores and from lead-zinc ores, as the production from all other ores declined. The silver-mining industry as such has declined to relatively small proportions in the United States; but as a by-product of the ores mentioned silver production was notably active in 1910.

In the world's output of silver Mexico still leads, with an output of approximately 72,500,000 ounces in 1910, and the United States remains second, with 57,137,900 ounces, followed by Canada with a production of nearly 32,000,000 ounces.

The average monthly price of silver in New York in 1910 was as follows:

Price of silver per fine ounce in New York in 1910, by months.

January	$0.52375	July	$0.54150
February	.51534	August	.52912
March	.51454	September	.53295
April	.53221	October	.55490
May	.53870	November	.55635
June	.53462	December	.54428

The average annual New York commercial value of silver per fine ounce for the last 10 years has been:

Annual price of silver per fine ounce in New York, 1901–1910.

1901	$0.60	1906	$0.68
1902	.53	1907	.66
1903	.54	1908	.53
1904	.58	1909	.52
1905	.61	1910	.54

PRODUCTION BY STATES FOR DECADE ENDING 1910.

GOLD.

The production of gold by States for the 10 years ending 1910 is shown in the following table:

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Production of gold in the United States, 1901–1910, by States.

State or Territory.	1901	1902	1903	1904	1905	1906
Alabama	$3,100	$2,500	$4,400	$29,300	$41,500	$23,500
Alaska	6,885,700	8,345,800	8,614,700	9,160,500	14,925,600	21,365,100
Arizona	4,083,000	4,112,300	4,357,600	3,343,900	2,691,300	2,747,100
California	16,891,400	16,792,100	16,104,500	18,994,800	19,197,100	18,832,900
Colorado	27,693,500	28,468,700	22,540,100	24,395,800	25,701,100	22,934,400
Georgia	124,500	97,800	62,000	96,900	94,800	23,700
Idaho	1,869,300	1,475,000	1,570,400	1,503,700	1,075,600	1,035,700
Maryland	.....	2,500	500	2,400	16,900	.....
Montana	4,744,100	4,373,680	4,411,900	5,097,800	4,889,300	4,522,000
Nevada	2,963,800	2,895,300	3,388,000	4,307,800	5,359,100	9,278,600
New Hampshire and Pennsylvania	.....	.....	.....	.....	.....	.....
New Mexico	688,400	531,100	244,600	381,900	265,800	266,200
North Carolina	55,580	90,700	70,500	123,900	123,900	90,980
Oregon	1,818,100	1,816,700	1,290,200	1,309,900	1,244,900	1,320,100
South Carolina	46,700	121,900	100,700	121,800	95,100	74,600
South Dakota	6,479,500	6,965,400	5,826,700	7,024,600	6,913,900	6,604,900
Tennessee	.....	.....	800	4,300	3,300	800
Texas	600	.....	.....	2,300	1,900	3,400
Utah	3,690,200	3,594,500	3,697,400	4,215,000	5,140,900	5,130,900
Virginia	5,300	3,100	13,500	3,800	5,000	10,300
Washington	580,500	272,200	279,900	327,900	370,000	103,000
Wyoming	12,700	38,800	3,600	16,400	23,700	5,700
Philippine Islands	.....	.....	.....	.....	.....	.....
Porto Rico	.....	.....	.....	.....	.....	.....
Undistributed	30,800	.....	9,700	.....	.....	.....
Total	78,666,700	80,000,000	73,591,700	80,464,700	88,180,700	94,373,800

State or Territory.	1907	1908	1909	1910	Total value.
Alabama	$27,400	$41,200	$29,200	$32,900	$235,000
Alaska	18,499,400	19,858,800	20,339,600	16,271,800	144,257,000
Arizona	2,664,000	2,500,000	2,626,800	3,413,200	32,539,200
California	16,853,500	19,329,700	20,703,600	20,441,400	184,141,000
Colorado	20,897,600	22,871,000	21,846,600	20,526,500	237,875,300
Georgia	64,800	56,200	43,400	24,000	688,100
Idaho	1,255,900	1,443,500	1,344,200	1,035,900	13,609,200
Maryland	.....	.....	.....	.....	22,300
Montana	3,472,600	3,160,000	3,750,100	3,720,400	42,141,800
Nevada	15,411,000	11,689,400	16,386,200	18,873,700	90,552,900
New Hampshire and Pennsylvania	.....	3,700	6,200	5,900	15,800
New Mexico	330,000	306,300	252,800	477,200	3,744,300
North Carolina	78,700	97,500	31,400	64,500	827,500
Oregon	1,222,200	905,900	829,000	681,400	12,438,400
South Carolina	58,100	53,700	7,400	37,800	717,800
South Dakota	4,138,200	7,742,200	6,573,600	5,380,200	64,649,200
Tennessee	3,800	3,700	4,300	2,800	23,800
Texas	1,000	500	400	400	10,500
Utah	5,121,600	3,946,700	4,213,300	4,312,700	43,063,200
Virginia	8,300	3,600	4,000	900	57,800
Washington	262,300	253,700	429,000	806,000	3,684,500
Wyoming	9,400	7,600	3,900	4,100	125,900
Philippine Islands	64,700	284,500	247,600	154,400	751,200
Porto Rico	1,200	600	600	1,000	3,400
Undistributed	.....	.....	200	.....	40,700
Total	90,435,700	94,560,000	99,673,400	96,269,100	876,215,800

The total output of gold in the United States for the last 10 years has been $876,215,800. Of this production Colorado contributed $237,875,300; California, $184,141,000; Alaska, $144,257,000; Nevada, $90,552,900; and South Dakota, $64,649,200. The figures show a steadily increasing output for the country as a whole, although the output decreased in 1901, 1903, 1907, and 1910. A generally increasing output for the decade is shown for Alaska, California, and Nevada; a fairly stationary output for South Dakota; and a generally decreasing production for Arizona, Colorado, Idaho, Montana, and Oregon. The comparison of the beginning with the ending of the decade shows how notable have been the increased output from Alaska and Nevada and the decreased output from Colorado.

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SILVER.

The production of silver, by States, for the 10 years ending 1910 is shown in the following table:

Production of silver in the United States, 1901–1910, by States, in fine ounces.

State or Territory.	1901	1902	1903	1904	1905	1906
Alabama	100	100		200	300	100
Alaska	47,900	92,000	143,600	198,700	169,200	203,500
Arizona	2,812,400	3,043,100	3,387,100	2,744,100	2,605,700	2,969,200
California	925,600	900,800	931,500	1,441,300	1,082,000	1,517,500
Colorado	18,437,800	15,676,000	12,990,200	14,331,600	12,942,800	12,447,400
Georgia	400	400	400	1,500	900	300
Idaho	5,542,900	5,854,800	6,507,400	7,810,200	8,125,600	8,836,200
Illinois						
Kentucky						
Maryland					100	
Michigan	81,000	110,800	50,000	127,800	253,000	186,100
Missouri					12,900	31,300
Montana	13,131,700	13,243,800	12,642,300	14,608,100	13,454,700	12,540,300
Nevada	1,812,500	3,746,200	5,050,500	2,695,100	5,863,500	5,207,600
New Hampshire and Pennsylvania						
New Mexico	563,400	457,200	180,700	214,600	354,900	453,400
North Carolina	20,300	20,900	11,000	14,800	13,200	24,700
Oregon	160,100	93,300	118,000	133,200	88,900	90,700
South Carolina	200	300	300	500	200	100
South Dakota	78,000	340,200	221,200	187,000	179,000	155,200
Tennessee		12,300	13,000	59,200	95,400	25,600
Texas	472,400	446,200	454,400	469,600	417,200	277,400
Utah	10,760,800	10,831,700	11,196,800	12,484,300	10,319,800	11,508,000
Vermont						
Virginia	700	5,900	9,500	6,700	200	100
Washington	344,400	619,000	294,500	149,900	119,400	42,100
Wyoming	21,400	5,000	200	4,400	2,700	1,100
Philippine Islands						
Undistributed			97,400			
Total	55,214,000	55,500,000	54,300,000	57,682,800	56,101,600	56,517,900

State or Territory.	1907	1908	1909	1910	Total quantity.
Alabama	600	400	200	300	2,300
Alaska	179,300	204,600	198,600	153,900	1,591,300
Arizona	2,903,100	2,900,000	2,523,600	2,655,700	28,544,000
California	1,590,000	1,703,700	2,304,900	1,791,600	14,188,900
Colorado	11,495,400	10,150,200	8,846,300	8,523,000	125,840,700
Georgia	700	200	200	300	5,300
Idaho	7,888,400	7,558,300	6,755,900	7,027,000	71,906,700
Illinois	2,900	2,000	900	2,000	7,800
Kentucky				100	100
Maryland					100
Michigan	331,300	294,100	217,600	262,200	1,913,900
Missouri	25,300	49,400	15,200	32,200	166,300
Montana	11,129,600	10,356,200	12,034,500	12,282,900	125,424,100
Nevada	8,280,500	9,508,500	10,119,200	12,366,000	64,649,600
New Hampshire and Pennsylvania		6,300	3,000	700	10,000
New Mexico	599,500	400,900	324,200	779,000	4,327,800
North Carolina	25,200	1,300	400	8,300	140,100
Oregon	96,000	56,100	69,600	43,800	949,700
South Carolina	100	200			1,900
South Dakota	106,600	197,300	196,300	120,600	1,781,400
Tennessee	58,300	60,900	65,300	69,800	459,800
Texas	305,300	447,000	408,100	364,400	4,062,000
Utah	11,406,900	8,451,300	10,551,100	10,445,900	107,956,600
Vermont	3,800				3,800
Virginia	200	300	6,400	200	30,200
Washington	84,000	86,800	75,200	204,900	2,020,200
Wyoming	1,600	3,500	1,800	1,300	43,000
Philippine Islands	100	1,300	3,000	1,800	6,200
Undistributed					97,400
Total	56,514,700	52,440,800	54,721,500	57,137,900	556,131,200

The total domestic output of silver for the last 10 years has been 556,131,200 fine ounces, and there has been little yearly variation during this period from the average annual output of 55,613,120

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ounces. Of the total output for the decade Colorado supplied 125,840,700 ounces and Montana 125,424,100 ounces—nearly half the production of the United States for 10 years coming from these two States—Utah supplied 107,956,600 ounces; Idaho, 71,906,700 ounces; Nevada, 64,649,600 ounces; and Arizona, 28,544,000 ounces. A steadily increasing production has come from Nevada, a steadily decreasing output from Colorado, and a fairly stationary annual output has been recorded for Arizona, Montana, and Utah. The output of Idaho has, on the whole, increased since 1901.

PRODUCTION OF GOLD AND SILVER SINCE 1792.

According to tables published by the Director of the Mint, the total production of gold and silver in the United States from 1792 to 1910, inclusive, is as follows:

Production of gold and silver in the United States, 1792–1910, by periods, in fine ounces.

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and since by the Director of the Mint.]

Years.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
1792–1847	1,187,170	$24,537,000	309,500	$404,500
1848–1872	58,279,778	1,204,750,000	118,568,200	157,749,900
1873–1910	98,311,950	2,032,286,500	1,776,130,700	1,439,201,900
Total	157,778,898	3,261,573,500	1,895,008,400	1,597,356,300

The following table shows the quantity and value of these metals produced in the United States since 1880:

Production of gold and silver in the United States from 1880 to 1910, inclusive, in fine ounces.

Years.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value
1880	1,741,500	$36,000,000	30,318,700	$34,717,000
1881	1,678,612	34,700,000	33,257,800	37,657,500
1882	1,572,187	32,500,000	36,196,900	41,105,900
1883	1,451,250	30,000,000	35,732,800	39,618,400
1884	1,489,950	30,800,000	37,743,800	41,921,300
1885	1,538,373	31,801,000	39,909,400	42,503,500
1886	1,686,788	34,869,000	39,694,000	39,482,400
1887	1,603,049	33,136,000	41,721,000	40,887,200
1888	1,604,478	33,167,500	45,792,700	43,045,100
1889	1,594,775	32,967,000	50,094,500	46,838,400
1890	1,588,877	32,845,000	54,516,300	57,242,100
1891	1,604,840	33,175,000	58,330,000	57,630,000
1892	1,597,098	33,015,000	63,500,000	55,662,500
1893	1,739,323	35,955,000	60,000,000	46,800,000
1894	1,910,813	39,500,000	49,500,000	31,422,100
1895	2,254,760	46,610,000	55,727,000	36,445,500
1896	2,568,132	53,088,000	58,834,800	39,654,600
1897	2,774,935	57,363,000	53,860,000	32,316,000
1898	3,118,398	64,463,000	54,438,000	32,118,400
1899	3,437,210	71,053,400	54,764,800	32,858,700
1900	3,829,897	79,171,000	57,647,000	35,741,100
1901	3,805,500	78,666,700	55,214,000	33,128,400
1902	3,870,000	80,000,000	55,500,000	29,415,000
1903	3,560,000	73,591,700	54,300,000	29,322,000
1904	3,892,480	80,464,700	57,682,800	33,456,000
1905	4,265,742	88,180,700	56,101,000	34,222,000
1906	4,565,333	94,373,800	56,517,000	38,256,400
1907	4,374,827	90,435,700	56,514,700	37,299,700
1908	4,574,340	94,560,000	52,440,800	28,050,600
1909	4,821,701	99,673,400	54,721,500	28,455,200
1910	4,657,018	96,269,100	57,137,900	30,854,500
Total	84,772,186	1,752,394,700	1,567,711,000	1,188,127,500

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IMPORTS AND EXPORTS.

The following table gives a summary of imports and exports of gold and silver during 1910:

Imports and exports of gold and silver during the calendar year 1910.

[Figures furnished by the Bureau of Statistics.]

Metals.	Imports.	Exports.	Excess of—	
			Imports.	Exports.
GOLD.				
Contained in domestic ore and base bullion		$470,062		$470,062
Contained in foreign ore and base bullion	$12,009,764		$12,009,764	
Domestic bullion, refined		2,626,478		2,626,478
Foreign bullion, refined	37,088,408	10,051	37,078,357	
United States coin	2,540,514	52,342,009		49,801,495
Foreign coin	7,583,832	3,326,222	4,257,610	
Total	59,222,518	58,774,822	53,345,731	52,898,035
Excess of imports			447,696	
SILVER.				
Contained in domestic ore and base bullion		346,735		346,735
Contained in foreign ore and base bullion	29,964,500	30,129	29,934,371	
Domestic bullion, refined		53,091,666		53,091,666
Foreign bullion, refined	12,766,812	3,109,831	9,656,981	
United States coin	1,124,347	576,230	548,117	
Foreign coin	2,022,509	206,382	1,816,127	
Total	45,878,168	57,360,973	41,955,596	53,438,401
Excess of exports				11,482,805

In 1910, according to the Bureau of Statistics of the Department of Commerce and Labor, Mexico sent to this country gold valued at $6,119,941 in ore and base bullion and at $17,226,985 in refined bullion, a total value in gold of $23,346,926; and silver valued at $17,079,787 in ore and base bullion and at $9,921,987 in refined bullion, a total value in silver of $27,001,774—a total value in both metals of $50,348,700.

During the same year Nova Scotia, New Brunswick, and Prince Edward Island sent to this country gold valued at $24,867 in ore and base bullion and at $13,030 in refined bullion; Quebec, Ontario, Manitoba, etc., sent gold valued at $191,187 in ore and base bullion and at $19,428 in refined bullion, and silver valued at $10,534,164 in ore and base bullion and at $28,968 in refined metal; and British Columbia sent gold valued at $4,319,607 in ore and base bullion and at $1,254,640 in refined bullion, and silver valued at $342,991 in ore and base bullion and at $129,020 in refined bullion. The total imports from Canada were gold valued at $5,822,759 and silver valued at $11,035,143, a total of $16,857,902, not including a large amount of gold and silver coin imported.

MINES REPORT.

METHOD OF COLLECTING STATISTICS.

The first table in this report presents the final official figures of the production of gold and silver in the United States in 1910 as agreed upon by the Bureau of the Mint and the United States Geo-

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logical Survey. With the relatively unimportant exceptions of domestic gold and silver contained in ores, mattes, etc., exported for reduction during the year, these figures record the actual production of gold and silver bullion from domestic ores in marketable form as metals, either refined or unrefined.

Owing to the difficulty of tracing this total gold and silver production back to its origin by States, counties, and mining districts, however, the Geological Survey attacks the problem of distribution by systematic investigation of the mine production of ores containing gold and silver during the calendar year, and of the output of the placer mines. In this way the state of the mining industry is studied in detail and classification of output by methods of production and by kinds of ore, as well as by mining districts, is obtained. The resulting figures form the basis of the mines report.

As already stated, the Bureau of the Mint takes into account, as the basis for figures of production, statistics of gold and silver in unrefined bullion deposited in the United States mints and assay offices, in fine bars of both metals produced by private refineries, and in ores, mattes, etc., exported for treatment.

The data for the mines report of the United States Geological Survey may be classified as follows: (1) Gold and silver from placers in nuggets, dust, and bullion; (2) gold and silver in mill bullion (obtained by amalgamation, cyanidation, chlorination, etc.) from mills of mine companies treating their own ores, tailings, dumps, etc.; (3) gold and silver in base bullion, matte, etc. (by assay value), from smelters treating their own ores; and (4) gold and silver in crude ore, concentrates, old tailings, slags, etc., (by assay value), shipped to custom mills and smelters—all four of these classes of data being for material treated at the mines or shipped from them during the calendar year.

The first item is the native gold (with silver in natural alloy) produced from placer mines and sold to Government mints and assay offices, and to refineries, banks, and traders. It is difficult to obtain accurate figures for this item only in some parts of Alaska, or from transitory miners elsewhere, or from miners who report only value received for their output. The second and third items cover metal production by mining companies whose mills and smelters treat their own ores and whose products go to the mints and refineries and are covered by confidential mine reports to the Survey. The fourth item, which covers raw mine products shipped for treatment, gives rise to the main apparent discrepancies between mine and mint-refinery reports on the production of gold and silver for the same calendar year. The discrepancies are due largely to the lapse of time between the disposal by shipment of the ore as reported from the mines and its arrival and metallurgical treatment at the mills or smelters, followed by the refining of the products, an interval in which large quantities of metals in ores reported from the mines as shipped in one year will be reported from refineries as produced in marketable form in the following year. For instance, ore shipped in November may be smelted in the following January, and the metal content would be reported from the mines for the calendar year preceding that for which it would be reported in marketable

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form by the smelters and refineries. The miners furnish the United States Geological Survey with confidential reports on assay values and tonnages of ore and concentrates shipped as the measure of their output and the mine figures are reported by the Survey so far as possible in terms of recoverable metal; and the smelters and refineries report the metals eventually produced, first as unrefined and finally as refined.

In using the mines report it should be noted that tonnages and metal output given are based not on ore mined but on ore treated or sold during the year. Of course most of the ore treated or sold is also mined during the same year, but some of it is necessarily mined during the preceding year. It must not be overlooked also that the mines report aims to give the recoverable content, not the assay content, of ore treated or sold. A part of the actual recovery is of course made during the early part of the following year for ores treated or sold late in the year under review, but the basis of the report is essentially metal recovered at whatever time from the tonnage treated or sold during the year covered by the report. For the second and third items enumerated the recovery figures are easily had, as the ore is treated on the ground, and the metal content of the bullion, either base or unrefined, is readily known. In the third item the refining loss and in the fourth item the combined concentrating, smelting, and refining losses must be considered. In the case of the precious metals the concentrating losses may be large and must be allowed for, but the smelting and refining losses are known to be very small and in ordinary practice to be more than offset by certain gains. These gains are of small quantities of precious metals (not paid for, but actually recovered from ores of copper, lead, and zinc) and certain differences in quantity of gold and silver between actual recovery and basis of settlement—for instance, silver is usually paid for on the basis of 95 per cent of the current New York price and gold at from $19 to $20 per fine ounce. From this it is seen that producers reporting in terms of dollars only will frequently be giving figures corresponding to production below actual final output of metal, and if they erroneously report net proceeds, as they sometimes do, their figures are still further below. Other gains offsetting refining and smelting losses are the relatively small quantities of precious metals, principally gold, not regularly reported from the mines, but coming from transitory placer miners whose production escapes estimate, from stolen ore treated in improvised "assay offices," and from smelter and refinery cleanings and similar material. Although mine reports in the aggregate may appear, therefore, to give figures of gold and silver that are too high, it is known from actual practice and comparison, later discussed, that final recoveries, especially for gold, are somewhat in excess of those reported from the mines.

COMPARISON OF MINT REPORT AND MINES REPORT.

Of the two plans outlined for ascertaining the gold and silver production of the United States it may be said that the one is a measure of the mining industry and the other a measure of the metallurgical industry; the one reports the production and recoverable content

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of mine output and the other the metal actually recovered in marketable form. The two methods will not produce exactly corresponding results nor should they be expected to do so. In addition to factors already noted as causing differences between the two sets of figures, it must be remembered that it is not always a simple matter for smelters to distribute their output according to the exact origin of the ore, and it is still more difficult for refiners to do so. It is therefore always possible that some ore of Canadian or Mexican origin is contributing to the output of metal thought by smelters to be of domestic origin.

The calendar year covered by both investigations is the same, but the period of mine production naturally corresponds to a period earlier than the period of actual production of marketable metal by the interval of time necessary for transporting, sampling, and treating the ore and for refining the products. This interval is practically negligible in the case of placer and mill bullion, but may be several months in the case of crude smelting ores and especially of ores concentrated before smelting.

The figures for the mint report and the mines report for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error due to the complex nature of the ores and of the methods of treatment. The figures of the mines report may be expected, on the whole, to fall normally below those of the mint report for the reasons outlined.

For the last six years the final figures for mint and mine returns have been as follows:

Production of gold and silver, 1905–1910, according to mint and to mine returns.

Years.	Mint.		Mine.	
	Gold.	Silver.	Gold.	Silver.
		Ounces.		*Ounces.*
1905	$88,180,700	56,101,600	$88,159,881	56,272,496
1906	94,373,800	56,517,900	97,219,645	57,362,455
1907	90,435,700	56,514,700	87,471,136	52,500,104
1908	94,560,000	52,440,800	91,914,891	50,878,140
1909	99,673,000	54,721,500	99,438,144	57,315,677
1910	96,269,100	57,137,900	94,933,778	57,598,509
Total	563,492,300	333,434,400	559,137,475	331,927,381

These figures show an excess of gold, according to mint reports, for the six years of $4,510,260, or a difference of a little over 0.8 per cent, and a corresponding excess of silver production of 1,909,767 fine ounces, or a difference of less than 0.6 per cent. As figures for Alaska placers are not claimed to be as close as these, the differences for the United States proper are even lower. It is thought these relatively small differences may be accounted for by the explanations already given. For figures of any one year an excess of mining over smelting and refining, whether of gold and silver or of base metal ore, or both, is indicated by larger figures in the mine reports for gold or silver, or both; and normal relations, or perhaps excess of smelting and refining over mining by drawing upon stocks, is suggested by the reverse figures.

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UNITS OF MEASUREMENTS.

Gold and silver are measured by the fine ounce. The computing tables to six decimals used by the Bureau of the Mint and the United States Geological Survey are based on the exact valuation for gold of $20.671834625323 per fine ounce. The average commercial price in New York for silver per fine ounce in 1909 was taken at 52 cents and in 1910 at 54 cents. The standard Survey unit for ore production is the short ton of 2,000 pounds.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES.

The following table gives the quantity and the value of gold and silver reported from the producing mines in 1910 to the United States Geological Survey. The increase or decrease of production shown results from comparison with the corresponding Survey mine figures for 1909:

Mine production of gold and silver in the United States in 1910 as reported to the United States Geological Survey, by States and Territories, in fine ounces.

State or Territory.	Gold.		Silver.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Gold, value.	Silver, quantity.
Alabama	1,622.16	$33,533	268	$145	+ $4,294	+ 56
Alaska	780,131.49	16,126,749	157,850	85,239	−4,284,967	+ 9,900
Arizona	152,350.58	3,149,366	2,566,528	1,385,925	+ 411,866	− 34,633
California	953,734.41	19,715,440	1,840,065	993,646	− 522,430	− 258,168
Colorado	992,028.93	20,507,058	8,509,598	4,595,183	−1,482,278	− 393,035
Georgia	1,722.25	35,602	335	181	− 25,018	+ 133
Idaho	53,059.73	1,096,842	7,369,742	3,979,661	− 356,980	+ 328,109
Illinois	.....	.....	2,022	1,092	.....	+ 1,021
Kentucky	.....	.....	84	46	.....	+ 84
Michigan	.....	.....	330,500	178,470	.....	+ 44,070
Missouri	.....	.....	33,096	17,872	.....	+ 18,908
Montana	180,462.26	3,730,486	12,162,857	6,567,942	− 61,024	− 215,857
Nevada	913,265.05	18,878,864	12,479,871	6,739,130	+2,638,901	+1,498,810
New Hampshire and Pennsylvania	291.07	6,017	526	284	− 913	− 2,967
New Mexico	23,337.26	482,424	843,987	455,753	+ 242,933	+ 446,204
North Carolina	3,291.68	68,045	9,053	4,889	+ 27,815	+ 8,554
Oregon	32,870.23	679,488	35,978	19,428	− 102,476	+ 8,151
Philippines	7,470.55	154,430	1,800	972	− 93,167	− 1,200
Porto Rico	48.37	1,000	.....	.....	+ 400	.....
South Carolina	1,853.92	38,324	46	25	+ 27,271	+ 2
South Dakota	261,334.18	5,402,257	118,800	64,152	−1,175,579	− 75,473
Tennessee	150.59	3,113	81,239	43,869	− 1,005	+ 23,602
Texas	20.46	423	380,322	205,374	+ 109	+ 5,878
Utah	195,052.11	4,032,085	10,466,971	5,652,164	− 174,463	−1,250,201
Virginia	42.96	888	128	69	− 2,862	− 4,697
Washington	38,126.51	788,145	205,345	110,886	+ 426,094	+ 125,857
Wyoming	154.75	3,199	1,478	798	− 887	− 276
Total	4,592,421.50	94,933,778	57,598,509	31,103,195	−4,504,366	+ 282,832

A decrease in production of gold valued at $4,504,366 and an increase of 282,832 fine ounces of silver are shown by the mines report for the United States for 1910 as compared with the corresponding figures for 1909.

The principal producing States ranked as follows in 1910 in output of gold: Colorado, California, Nevada, Alaska, South Dakota, Utah, Montana, Arizona, and Idaho. The relative positions are the same as they were in 1909 except that in 1910 Alaska dropped from second

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to fourth place, and California and Nevada each moved up one place. No other State or Territory produced as much as $1,000,000 in gold in 1910. The most notable increases in 1910 were: $2,638,901 in Nevada, $426,094 in Washington, $411,866 in Arizona, $242,933 in New Mexico, $27,815 in North Carolina, and $27,271 in South Carolina. The heaviest decreases were, $4,284,967 in Alaska, $1,482,278 in Colorado, and $1,175,579 in South Dakota.

In silver output the principal producing States and Territories ranked as follows: Nevada, Montana, Utah, Colorado, Idaho, Arizona, and California. The relative positions were the same as in 1909, except that in 1910 Nevada moved from third place to first, sending Montana from first to second and Utah from second to third. The largest increases in silver production in 1910 were: 1,498,810 ounces in Nevada, 446,204 ounces in New Mexico, 328,109 ounces in Idaho, and 125,857 ounces in Washington. The largest decreases were: 1,250,201 ounces in Utah, 393,035 ounces in Colorado, 258,168 ounces in California, and 215,857 ounces in Montana.

GOLD AND SILVER INDUSTRY BY STATES AND TERRITORIES.

Alaska.—The gold production of Alaska in 1910 was $16,126,749, a decrease from that of 1909 of $4,284,967. The output from siliceous ores was $4,105,459 against $4,117,440 in 1909, and that from copper ores was $36,484 against $41,638 in 1909. The production from placers, however, declined from $16,252,638 in 1909 to $11,984,806 in 1910, and here the heavy falling off in Alaska gold production is mainly found. The output by geographic provinces was as follows: From the Pacific coast belt, including southeastern Alaska and Prince William Sound, $4,182,730, against $4,264,716 in 1909; from the Copper River and Cook Inlet region, $351,630, against $265,000 in 1909; from the Yukon and Kuskokwim basins, $8,062,389, against $11,580,000 in 1909; and from Seward Peninsula and northwestern Alaska, $3,530,000, against $4,302,000 in 1909. There was increased output of $86,630 from the second of the above-named regions, but decreases of $81,986, $3,517,611, and $772,000, respectively, from the first, third, and fourth. About three-fourths of the gold from Alaska still comes from the placers, but this ratio is on the decline, as the placer output tends to decrease while the production from deep mines is relatively on the increase.

The auriferous lode mines of southeastern Alaska produced $3,839,626 in gold in 1910, against $4,098,900 in 1909. The great Treadwell low-grade gold mines of the Juneau district continued to be the heaviest producers. A new auriferous lode district was developed in 1910 on Port Valdez, in Prince William Sound, and there was great activity in gold-quartz prospecting on Kenai Peninsula and elsewhere in Alaska during the year. The Fairbanks district, in the Yukon basin, produced only $6,100,000 in gold in 1910, against $9,650,000 in 1909, and here the decline in Alaskan output is chiefly found now, and to be expected in the future, as the better-known and higher-grade gravels are being worked out, notwithstanding discoveries of new ground in this district, as on Fish and Goldstream Creeks in 1910. The new Innoko-Iditarod district, in the Yukon basin, is estimated to have produced $825,000 in 1910. In

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Seward Peninsula the Nome precinct, including the Solomon River region, produced about $2,200,000 in gold in 1910, the Fairhaven precinct about $500,000, the Council somewhat less, and the Kougarok and Port Clarence precincts the remainder. Sixteen dredges were operated, much development work was done, and in spite of decreased output, mining was prosperous in Seward Peninsula in 1910.

The production of silver in Alaska in 1910 was 157,850 fine ounces, an increase of 9,900 ounces over the output for 1909. Of the total output 30,123 ounces was derived from siliceous gold ores, 26,388 ounces from copper ores, and 101,339 ounces came from gold placers. The silver production in Alaska is entirely a by-product in the refining of gold and copper.

Arizona.—The gold production of Arizona was $3,149,366 in 1910, against an output of $2,737,500 in 1909. This was the largest production since 1904 and was due to increased output of siliceous ores and to increased recovery from copper ores. Mohave County led in output with $1,145,022, mainly from milling and cyaniding siliceous ores, and chiefly from the Gold Road and the Tom Reed mines of the San Francisco district. Yavapai County ranked second with $881,970, chiefly from copper ores of the Verde district, but also largely from dry or siliceous ores of the Martinez and other districts. Cochise County was third in output in 1910, with $587,476, chiefly from copper ores and from the Warren (Bisbee), Tombstone, and Turquoise districts. Yuma County was fourth with $386,207, chiefly from siliceous ores, largely from the Golden Star mine in the Koja district. About half the total gold production from Arizona ore was obtained by amalgamation and cyanidation and the remainder by smelting. Of the total production in 1910 of 152,351 ounces of gold in Arizona, 95,395 ounces came from siliceous ores, and 52,707 ounces from copper ores. The total placer gold output was only $25,990 in 1910.

The production of silver in Arizona in 1910 was 2,566,528 fine ounces, against 2,601,161 ounces in 1909. Cochise County produced about half the total output, or 1,208,274 ounces, three-fourths of which was recovered from copper ores mined at Bisbee. Yavapai County ranked second with 699,702 ounces, mainly from copper ores, and Gila, Greenlee, Mohave, and Pima counties followed in order named, with over 100,000 ounces each. Of the total output copper ores yielded 1,934,363 ounces, of which 980,869 ounces were from Cochise County, 614,829 from Yavapai, and 165,636 from Gila. Siliceous ores yielded 440,126 ounces, of which 149,275 were from Cochise County, 82,904 from Greenlee, 76,691 from Santa Cruz, and 74,255 from Yavapai. Lead ores supplied 119,034 ounces, of which 66,915 came from Cochise County and 32,618 from Mohave. Zinc ores also supplied 34,227 ounces in 1910, all from Mohave County. Copper-lead ores yielded 38,611 ounces, of which 23,632 ounces were from Pima County and 11,210 from Cochise.

California.—The mine production of gold in California in 1910 was $19,715,440, a decrease of $522,430 from the output for 1909. The total output of placer gold decreased, but gold production increased in hydraulic and dredge placer mining, though falling off heavily in drift mining and over 50 per cent in surface sluicing. In total deep-mine output the production decreased from both siliceous and copper ores but increased from lead ores. The latter source, however, is not important in California. By counties, the largest gold increases

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in 1910 were in Yuba, where there was an increase of $734,408, due mainly to dredging; in Amador, where there was an increase of $347,461, mainly from quartz mining on the Mother Lode, and in Sierra, where there was a net increase of $122,363, entirely from quartz mining, as placer production decreased in this county in 1910. The largest decreases were $499,288 in Butte County, mainly in dredging; $310,077 in Tuolumne County, in quartz mining on the Mother Lode; $292,806 in Calaveras County, mainly in mining on the Mother Lode, but also from placers; $272,940 in Sacramento County from dredging; and $126,752 in Nevada County, where placer production fell off over one-half, although production from quartz mining in the Grass Valley region increased in 1910. The counties producing over $1,000,000 in gold in 1910 were Yuba, with $3,204,273; Amador, with $2,646,246; Nevada, with $2,533,483; Butte, with $2,487,791; Shasta, with $1,533,728; Sacramento, with $1,396,874; and Calaveras, with $1,147,705. Of these Yuba, Butte, and Sacramento counties are essentially producers from dredging; Amador and Calaveras are Mother Lode counties; Nevada County production is mainly from the gold-quartz ores of Grass Valley; and Shasta County produces gold in important quantities mainly from siliceous and from copper ores. Butte County, which ranked first in total gold production in California in 1909, dropped to fourth in 1910; Nevada County, which ranked second, dropped to third; Yuba County, which ranked third, rose to first; and Amador County, which ranked fourth, rose to second. The changes were mainly due to increased recovery by dredges in Yuba County and decreased output from this source in Butte County, to increased quartz-gold output in Amador County, and to decreased production from drift mining and surface sluicing in Nevada County. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose ores are mostly gold quartz, produced altogether in gold $4,408,990 in 1910, as against $4,821,416 in 1909. Of these, Amador County alone increased production in 1910, the others showing decreases. The total average recovery in gold and silver from Mother Lode ores in 1910 was valued at $3.78 per ton, against $3.60 in 1909, $3.72 in 1908, and $4.66 in 1907. The total output of gold from dredging in California continued increasing in importance in 1910, when the production from this source was $7,550,254—the largest in the history of the industry. The increase is to be credited mainly to Yuba County, however, and in smaller degree to Siskiyou and Trinity counties, for the other great dredging counties, Butte and Sacramento, decreased their output, owing to decreasing tenor of the gravels worked. The total production of gold from dredging in California from 1899, when the output was $206,302, to 1910, inclusive, has been $40,318,775. The rate of increase rose rapidly every year until 1906, but since 1908 the rate has steadily declined. Placer gold production from all sources in California in 1910 was valued at $8,888,795, against $9,104,433 in 1909. Of the total for 1910 $635,498 came from 168 hydraulic mines, $7,550,254 from 72 dredges operated by 41 companies, $516,929 from 139 drift mines, and $186,114 from 185 sluicing mines; in 1909, $605,608 came from 134 hydraulic mines, $7,382,950 from 63 dredges, $739,797 from 118 drift mines, and $376,078 from 241 sluicing mines. The total gold production from California deep mines in 1910 was $10,826,645, against $11,133,437

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in 1909. Of this total, $10,143,780 was derived from siliceous ores, against $10,433,402 from this source in 1909; $658,288 came from copper ores against $691,062 in 1909; and $24,577 was from lead ores against $8,975 in 1909.

The production of silver in California in 1910 was 1,840,085 fine ounces, against 2,098,253 fine ounces in 1909. From refining of placer gold was recovered 41,856 fine ounces, against 40,967 ounces in 1909; from siliceous (mainly gold-quartz) ores were derived 257,355 ounces, against 456,826 ounces in 1909; from refining of copper from copper ores 1,363,668 ounces, against 1,539,665 ounces in 1909; and from silver-lead ores 177,206 fine ounces, against 60,795 ounces in 1909. The copper mines of Shasta County produced 1,192,520 ounces of silver in 1910, against 1,386,817 ounces in 1909, and those of Calaveras County 144,683 ounces, against 119,696 ounces in 1909. Inyo County produced its entire quantity of silver from silver-lead ores in 1910, and very much the greater part of it in 1909. From siliceous ores Kern County produced 64,830 ounces in 1910, against 195,365 ounces in 1909. Although the greater part of the California silver production is from refining of copper and of gold, there were 4 silver mines producing in Kern County and 5 in San Bernardino County in 1910.

Colorado.—In 1910 the production of gold in Colorado was $20,507,058, a decrease of $1,482,278 from the output for 1909. The production of Cripple Creek decreased $468,420, pending the unwatering of the deeper levels by the Roosevelt drainage tunnel and owing to the unwillingness of operators to extract ore from great depths at heavy cost for pumping. The output of Ouray County showed a decrease of $848,978, against an increase of $1,016,127 in 1909. Notable decreases were recorded in 1910 also from Lake, Park, Gilpin, and Summit counties, and smaller decreases from Boulder, Clear Creek, Dolores, and Eagle counties. The production of La Plata County increased $263,725, that of San Miguel County $209,742, and that of Gunnison County $125,479 in 1910; and smaller increases were recorded from Chaffee, Mineral, and San Juan counties. The chief gold-producing counties of Colorado, with their outputs for 1910, were Teller (Cripple Creek), with $11,002,253; San Miguel, with $2,494,793; Ouray, with $2,195,847; and Lake (Leadville), with $1,213,134. Other important producing counties in 1910 were San Juan, with $710,527; Gilpin, with $687,902; and Clear Creek, with $522,524. The output of La Plata County was $390,844, of Summit $368,766, and of Park $265,547. Gunnison County produced $233,972, and Boulder and Mineral counties each produced over $100,000 in 1910. The San Juan region, including San Juan, San Miguel, Ouray, Dolores, Hinsdale, Montezuma, and La Plata counties in southwestern Colorado, produced altogether $5,822,422, against $6,170,201 in 1909. The Clear Creek region, including Boulder, Clear Creek, and Gilpin counties, produced $1,350,337, against $1,586,991 in 1909. Of the total ore tonnage mined, dry or siliceous ores made up 80.4 per cent and yielded $19,498,099 of the gold, or 95 per cent. Placers yielded nearly 2 per cent of the gold, and the remainder came from lead, copper, zinc, and lead-zinc ores. The total placer gold production in Colorado in 1910 was $395,465, a decrease of $63,027. Summit County with 4 dredges and 5 small placers, mainly in the Breckenridge district, yielded over 88 per cent

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of the placer gold production. Hydraulic mines in Chaffee and Park counties produced the greater part of the remainder, but there was an increased yield from Routt County, and a dredge also made an output in Costilla County. In metallurgical treatment nearly 60 per cent of the total tonnage of Colorado in 1910 was sent to amalgamating, cyaniding, or chlorinating mills, and the remainder was smelted, with or without previous concentration. Of the Cripple Creek tonnage 95 per cent was treated at local cyanide plants at Cripple Creek and at cyanide, chlorination, and concentrating plants at Colorado City.

The silver production of Colorado in 1910 was 8,509,598 fine ounces, against 8,902,633 ounces in 1909. Lake County (Leadville), which made an increase in output of over 500,000 ounces in 1909, showed a decrease of 101,627 ounces for 1910, but the output was 39 per cent of the State yield in 1910, against 38 per cent in 1909. There was notably increased silver output in Chaffee, La Plata, and Ouray counties, but the Pitkin County production again decreased, and there was a considerable decrease also in San Miguel County. Smaller decreases were recorded in all the other counties except Clear Creek, Gunnison, Park, Saguache, and Summit. The production of the leading counties in 1910 was as follows: Lake, 3,322,015 fine ounces; San Miguel, 1,144,050 ounces; San Juan, 782,250 ounces; Mineral, 773,722 ounces; Pitkin, 477,813 ounces; Clear Creek, 475,174 ounces; and Ouray, 414,250 ounces. These 7 counties combined furnished nearly 87 per cent of the total. The districts of Leadville, Aspen, and Creede combined, producing mainly smelting ores, made an output of 4,409,274 ounces, against 4,657,884 ounces in 1909. The San Juan region produced 2,625,033 ounces in 1910, against 2,737,239 ounces in 1909. Siliceous or dry ores yielded 6,117,719 ounces of silver in Colorado in 1910, or 71.9 per cent of the total output; lead ores yielded 1,050,611 ounces, or 12.3 per cent; zinc and lead-zinc ores, 711,810 ounces, or 8.4 per cent; copper ores, 436,358 ounces, or 5.1 per cent; and copper-lead ores 188,146 ounces, or 2.2 per cent. The quantity of silver recovered from placer gold was nominal.

Idaho.—The gold production of Idaho in 1910 was $1,096,842, a decrease of $356,980, due largely to the closing of the Buster mine, in Idaho County, and the Trade Dollar mine, in Owyhee County, and to decreased output from other mines in Custer and Lemhi counties. Siliceous ore furnished about 71 per cent of the output, mainly from Owyhee, Elmore, and Boise counties, and placers $242,546, or 22 per cent. In order of production Owyhee County led with $388,728, followed by Boise with $199,430, and Elmore with $180,282. No other county produced $100,000 in gold in 1910. The Boise Basin region, in Boise County, produced $168,051 in gold in 1910, of which $127,954 was from 42 placers, including dredges, and the remainder from 7 deep mines, against $175,852 from 9 deep mines and 39 placers in 1909. The Middle Boise district, in Elmore County, produced $127,818 in gold in 1910, mainly from gold-milling ore. The Bagdad-Chase mine, the largest producer, was closed in March, 1910, but the mill was run on tailings. The Elk City district, in Idaho County, produced only $37,533 in gold in 1910 against $174,036 in 1909, the decrease being largely due to the idleness of the Buster mine. The Carson district, in Owyhee County, produced $388,268 in gold in 1910 against $424,237 in 1909, the decrease being due in large part to the

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closing of the Trade Dollar mill, in March, 1910. Placers in Idaho supplied $242,546 in gold, of which $91,247 was recovered by 6 dredges, and the remainder was chiefly from hydraulic and sluicing mines.

The silver production in Idaho was 7,369,742 fine ounces, an increase of 328,109 ounces over the output of 1909. With the resumption of shipments of lead ore from Gilmore there was a marked increase in output from Lemhi County, and the Stewart and Caledonia mines assisted in increasing the production of Shoshone County, which yielded nearly 91 per cent of the production in 1910; but a large decrease was reported from Owyhee County. Of the total silver production in Idaho, lead ores supplied 88 per cent, or 6,479,636 ounces; copper ores 6.4 per cent, or 475,363 ounces; and siliceous ores 5.3 per cent, or 393,795 ounces. As usual, the Coeur d'Alene region of Shoshone County, including the Hunter, Lelande, Yreka, and smaller districts, supplied the bulk of the State output—6,703,080 ounces in 1910, against 6,201,157 ounces in 1909. Of the county production in 1910, there were derived from lead ores 6,238,518 ounces and from copper ores 446,471 ounces—an increase from the first source, but a decrease from the second. Owyhee County produced 341,482 ounces of silver from siliceous ores in 1910, and Lemhi County 150,185 ounces, mainly from lead ores. Crude ore shipped to smelters contained 2,588,431 ounces of the Idaho output in 1910, concentrates contained 4,463,517 ounces, and bullion from gold and silver mills contained 315,356 ounces.

Michigan.—The Michigan copper mines produced 330,500 fine ounces of silver in 1910 against an output of 286,430 ounces in 1909. The silver production is mainly from the electrolytic refining of the copper produced, and, as refining may proceed at a different rate from mining, increased production of silver indicates increased refining only. The average recovery per ton of "rock" was 0.03 ounce in 1910. Of the total output of the State, 293,387 ounces of silver, or 88.7 per cent, came from Houghton County, and the remainder, 37,113 ounces, was from Keweenaw County. Six of the 8 mines producing silver were in Houghton County, in which the production was mostly from amygdaloid ores.

Missouri, Illinois, and Kentucky.—The lead and zinc mines of the Central States contribute little silver as a by-product. The small production is mainly from lead ores of southeast Missouri, where the silver content is only about 1.2 ounces per ton of concentrates saved, and lead from only about one-sixth of these ores is desilverized. The output of silver in Missouri in 1910 was 33,096 fine ounces from 35,002 short tons of concentrates, against 14,188 ounces from 31,000 tons in 1909.

In Illinois the silver production in 1910 was 2,022 fine ounces from 398 tons of lead concentrates, against an output of 1,001 ounces from 403 tons in 1909.

In western Kentucky 84 fine ounces of silver were recovered in 1910 from 56 tons of lead concentrates obtained from lead-fluorspar mines.

Montana.—The production of gold in Montana in 1910 was $3,730,486, a decrease of $61,024 from the output of 1909. The decrease was in output from dry or siliceous and copper ores, as the gold production from placers, lead, zinc, and copper-lead ores

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increased. Madison County led in total gold production in Montana in 1910, with $810,921, of which $466,222 came from placers and the remainder chiefly from siliceous gold ore. As the total placer output of gold in Montana was $575,917, against $543,372 in 1909, the great bulk of the production was from Madison County, where 3 dredges and 4 other placers in Alder Gulch produced most of the output. Silver Bow County ranked second, with a production of $765,155, almost entirely from the copper ores of Butte; and Fergus County was third in rank, with an output of $636,752, from gold-quartz ores of the North Moccasin and the Warm Springs districts.

The silver output of Montana in 1910 was 12,162,857 fine ounces, against 12,378,714 ounces in 1909. The decreased output of silver in the State in 1910 was due to curtailment of copper production. The copper ores alone produced 9,153,590 ounces, of which 9,139,533 ounces came from the Butte mines of Silver Bow County. Silver Bow County supplied also 582,185 ounces from dry or siliceous ores, 658,516 ounces from zinc ores, and smaller quantities from placers, lead ore, and copper-lead ore, the total silver output for the county being 10,400,840 ounces in 1910, against 10,609,328 ounces in 1909. Jefferson County produced 1,029,579 ounces in 1910, mainly from dry or siliceous ores, and from the Elkhorn district. Granite County produced 308,423 ounces, of which 303,434 ounces were from dry or siliceous ores and chiefly from the Flint Creek district. Madison County produced 115,745 ounces in 1910, of which 109,826 ounces were from dry or siliceous ores.

Nevada.—The production of gold in Nevada in 1910 was $18,878,864, an increase of $2,638,901 over the output of 1909, and of $7,515,923 over the output of 1908. The great bulk of the production came as in 1909 from dry or siliceous ores, the small remainder coming almost wholly from copper ores, placers, and lead ores, in order given. The siliceous ores were produced mainly in Esmeralda County, where Goldfield is the chief district, and in Nye County, in which are the Tonopah and other mines, Humboldt County, in which the new camp of National is of importance, ranking third in output of this class of ore. The production from copper ores was mainly from the Robinson or Ely district, of White Pine County, and that from placers chiefly from Manhattan and Round Mountain districts in Nye County. In county production Esmeralda led with $11,994,338 (against $10,521,562 in 1909), of which the great Goldfield mines supplied $11,137,150 (against $9,383,261 in 1909), and the Silverpeak mines produced $842,806. Nye County followed with $3,661,967 in 1910 (against $2,945,942 in 1909), of which the Tonopah district produced $2,303,702, the Bullfrog district $416,891, the Manhattan district $361,602, and the Round Mountain district $392,098. Humboldt County was third in importance of gold output, with a production of $1,458,486, mainly from the one mine which has been the chief producer from notably rich ore of the new camp of National. Storey County produced $502,843 in 1910, from siliceous ores of the Comstock mines, and White Pine County $457,565, mainly from copper ores of the Ely district. Increased gold production in Nevada was especially notable from the Goldfield, Tonopah, and National mines.

The silver output of Nevada in 1910 was 12,479,871 fine ounces, against 10,981,061 ounces in 1909. Of the total production Nye

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County furnished 10,550,303 ounces, mainly from the siliceous ores of Tonopah. Mineral County ranked second with an output of 522,987 ounces, mainly from the Hawthorne and the Rawhide districts. Storey County followed with 320,716 ounces from siliceous ores of the Comstock. Humboldt County was fourth in 1910 with a production of 280,632 ounces, chiefly from National. White Pine County produced 199,222 ounces, mainly from copper ores, and Esmeralda County 198,703 ounces, largely from the Goldfield ores. Of the total silver production in Nevada in 1910 siliceous ores produced 11,763,012 ounces, mainly from Tonopah, lead ores 583,282 ounces, chiefly from the Hawthorne district, and copper ores 107,365 ounces, mostly from the Ely district.

New Hampshire and Pennsylvania.—There was a small production of gold and silver from the New Milan copper-pyrite mine in New Hampshire in 1910, and the figures of output have been combined with those of the recovery of precious metals from copper-pyrite concentrates from ores of the Cornwall iron mine of Lebanon County, Pa. Concentrates from the latter are saved by magnetic separation, and briquetted, for sale to copper smelters, by the Gröndal process, the result being increased purity of the iron ores and a marketable product of copper pyrite. The production in 1910 from both States was $6,017 in gold and 526 fine ounces of silver.

New Mexico.—The production of gold in New Mexico was $482,424 in 1910, against $239,491 in 1909, an increase of $242,933. Socorro County led in output of gold with $311,114, followed by Grant with $65,932, and Lincoln with $55,276. Siliceous ores, mainly from Socorro, Lincoln, and Grant counties, produced over 88 per cent of the gold output; copper ores, mainly from Grant County, furnished over 6 per cent, and placers supplied $26,094, or 5.4 per cent of the total. The smelters in New Mexico remained idle in 1910, the shipping ores going mainly to the El Paso and the Copper Queen plants. The gold ores, however, are mainly siliceous milling and cyaniding ores. The development of mines and erection of gold mills in New Mexico in 1910 indicates further increase in output in 1911.

The silver production of New Mexico in 1910 was 843,987 fine ounces, against 397,783 ounces in 1909, an increase of 446,204 ounces. Socorro County produced 662,000 ounces in 1910, or 78.4 per cent of the total, chiefly from siliceous ore from the Mogollon district, and the Magdalena district of Grant County supplied 156,557 ounces, or 18.5 per cent, chiefly from siliceous, copper, and lead ores.

Oregon.—The gold production of Oregon in 1910 was $679,488, against $781,964 in 1909, a decrease of $102,476. Baker County again led in production of gold, with an output of $401,002, followed by Josephine County with $150,048. The total placer production was $170,925, of which Josephine County produced $86,775 and Jackson County $37,926. Of the gold output from quartz mines Baker County produced $389,726, in 1910, and Josephine County $63,273. Six dredges in Oregon produced $34,010 in 1910, the greater part of which came from Jackson County. Southwestern Oregon produced $209,324 in gold in 1910 (a decrease of $64,921), of which the placer output was $130,103 (a decrease of $55,149). Northeastern Oregon produced $470,164 in gold (a decrease of $37,555), of which the placer output was $40,822 (an increase of $4,756).

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The silver production of Oregon in 1910 was 35,978 fine ounces, against 27,827 ounces in 1909. Of the total output Baker County produced 29,835 ounces, mainly from siliceous ores, against 19,514 ounces in 1909. Siliceous ores supplied 34,204 ounces of silver in Oregon in 1910, an increase of 8,658 ounces from this source.

Southern Appalachian States.—The combined gold production from Alabama, Georgia, North Carolina, South Carolina, Tennessee, and Virginia was $179,505 in 1910, against $149,010 in 1909. The increase was due largely to resumption of normal operations at two of the largest mines in North Carolina and South Carolina, although offset somewhat by the closing down of the Franklin mine in Georgia, which caused a considerable decrease in the total gold output of that State, and by smaller decreases in the gold production of Tennessee and Virginia. North Carolina resumed the lead in gold output, with a production of $68,045, followed by South Carolina with $38,324, Georgia with $35,602, and Alabama with $33,533. The production was chiefly from gold-quartz ores, mined mainly in North Carolina, South Carolina, and Alabama. Georgia led in output from placers, followed by North Carolina. The placers yielded 17 per cent of the total output.

The silver production of the Southern States in 1910 was 91,069 fine ounces, against 63,419 ounces in 1909. Of the total output 81,237 ounces were derived from refining of copper from the Ducktown district in Tennessee, the greater part of the remainder coming from copper ores of North Carolina.

South Dakota.—The production of gold in South Dakota in 1910 was $5,402,257, against $6,577,836 in 1909, a decrease of $1,175,579, owing largely to labor troubles in the Black Hills in the early part of the year. The output of gold is almost wholly from siliceous ore, and the greater part of this is low-grade milling-amalgamating-cyaniding ore. The great Homestake mines and mills in Lawrence County continue to produce three-quarters of the output. The total production in South Dakota, from the discovery of gold in 1875 to the end of 1910, has been $155,303,594.

The silver output of South Dakota, derived mainly from refining mill bullion, was 118,800 fine ounces in 1910, against 194,273 ounces in 1909.

Texas.—The gold production in Texas is merely nominal, and a by-product, being $314 in 1910 against $423 in 1909. The production of silver in 1910 was 380,322 fine ounces, against 374,444 ounces in 1909. The output is almost wholly from the milling of oxidized dry or siliceous ores of the Shafter district in Presidio County.

Utah.—The gold production of Utah in 1910 was $4,032,085, against $4,206,548 in 1909. Of the total output $754,127 was recovered in amalgamation and cyanidation, chiefly in the Camp Floyd district of Tooele County and in Iron, Piute, Salt Lake, and Boxelder counties. The remainder of the gold production was almost entirely from the smelting of copper, lead, and dry ores and concentrates. Salt Lake County ranked first in gold output with $1,776,058, mainly from copper ores, and from the Bingham or West Mountain district. Juab County was second, with $1,181,366, chiefly from copper, lead, and siliceous ores and from the Tintic district. Tooele County followed with $721,361, mainly from dry or siliceous ores of the Camp Floyd district, and Utah County was fourth with $193,234 from lead ores of the Tintic district.

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The silver production of Utah was 10,466,971 fine ounces in 1910, giving the State third rank in the United States. Juab County produced 3,835,063 ounces, of which 2,634,361 ounces came from lead ore, 829,994 ounces from copper ore, and 370,026 ounces from dry or siliceous ores, chiefly from the Tintic district. Summit and Wasatch counties together (Park City region) produced 2,571,771 ounces, of which 1,513,444 ounces came from lead ores and 989,135 ounces from lead-zinc ores. Third in rank was Salt Lake County, with 2,006,131 ounces, of which 1,186,072 ounces came from copper ores, 361,104 ounces from lead ores, 239,263 ounces from lead-zinc ores, and 126,893 ounces from copper-lead ores, mainly from Bingham district, but also in part from the Big and Little Cottonwood districts. Utah County ranked fourth with 1,514,384 ounces from lead ores of the Tintic district. Of the total silver output of Utah in 1910 lead ores produced 6,423,523 ounces, copper ores 2,036,909 ounces, and lead-zinc ores 1,228,398 ounces.

Washington.—The gold production of Washington in 1910 was $788,145, an increase over that of 1909 of $426,094, or nearly 116 per cent; and it was the largest output in the last seven years. Ferry County, in which is the important Republic district, again led in production with $714,808, followed by Stevens with $30,182. The siliceous ores, mainly from these counties, yielded the bulk of the output, the placer production, mainly from Kittitas County, being very small. The output of gold from the Republic district was $713,604 in 1910, against $209,114 in 1909, mainly from siliceous smelting ore.

The silver production was 205,345 fine ounces in 1910, an increase of 125,857 ounces over the output of 1909. The production was mainly from siliceous smelting ores of Ferry County and from siliceous copper and lead smelting ores in Stevens County.

Wyoming.—The production of gold in Wyoming in 1910 was $3,199, against an output of $4,086 in 1910. Of the total gold production, $1,674 came from siliceous ores, $871 from copper ores, and $654 from placers in 1910.

The silver production, mainly from copper ores, decreased from 1,754 fine ounces in 1909 to 1,478 ounces in 1910.

Philippine Islands.[1]—The gold production of the Philippines in 1910 was $154,430, an apparent decrease of $93,167 from the output of 1909. The silver production, merely that of recovery in refining the gold produced, is estimated at 1,800 fine ounces for 1910. Of the three chief mining districts of the Philippines the most important at present, and the youngest, is that of Baguio, in the mountains of the subprovince of Benguet in central Luzon.[2] According to Eddingfield[3] the majority of the deposits are fissure veins in andesite, although contact deposits between andesite and limestone and between andesite and diorite have been reported. The veins occur in groups, and about 250 have been uncovered. The general strike is east, parallel with the mountain trend, and the width varies from 1 to 18 feet. The gangue varies greatly, including white quartz, banded crystalline quartz, calcite, rhodocrosite,. brown manganese oxide, brecciated

[1] Advance figures for the output of the Philippines in 1910 have been kindly furnished by the Governor General by cable through the Bureau of Insular Affairs, War Department.

[2] Ferguson, H. G., The gold deposits of the Philippine Islands: Econ. Geology, vol. 6, No. 2, March, 1911, p. 115.

[3] Eddingfield, F. D., The Baguio mineral district: Mineral Resources of the Philippine Islands, Bureau of Science, Manila, 1910, pp. 14–17.

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quartz, and silicified andesite. The gold is usually about 50 per cent free milling. It is also included in pyrite and occurs rarely as gold-silver telluride. The ore is not usually of high grade. The Bua and the Consolidated mines are the most extensively operated, and each is equipped with a modern free-discharge stamp mill and cyanide plant. The Camote, Headwaters, and Kelley mines are also developed, the first two of which are equipped with plants. The Arroroy district in the northeastern part of the island of Masbate, which has undoubtedly produced much gold in the past from placers and shallow workings, has been described in some detail by Ferguson.[1] The oldest rocks are slates of undetermined age, intruded by diorite and more basic plutonic rocks, and associated with later volcanics, chiefly augite andesite, and more basic rocks. Remnants of dark-blue limestone of the middle Tertiary are found. The majority of the veins strike northwest along tectonic lines. The veins are confined to the igneous rocks and are, as a rule, wide and regular. The primary ore is chiefly gold, associated with pyrites in a quartz-calcite gangue, but the veins have been oxidized to considerable depths and the altered upper portions only have been mainly developed to date. Production from Arroroy has been relatively small in recent years, pending development work, but the largest mill in the Philippines was in course of erection and was expected to be completed in 1911 for the Colorado group. Dredging has been tried on the streams of this district, but has failed to prove profitable to date. The Paracale district, in Ambos Camarines, on the Pacific coast of Luzon, has been an important producer of gold in early times from placers and shallow workings, and has been the scene of considerable dredging activity and some underground exploration work of recent years. There are now three dredges in the district, and one modern 20-stamp mill has been recently put up. The dredging field is important, though heavy vegetation, sticky bottom clays, and much black sand offer difficulties. The rocks of the district are mainly regionally metamorphosed sandstones, shales, and intruded granite, together with basaltic and andesitic flows and dikes. Two properties have been chiefly developed, one with a calcite stringer lode carrying sulphides, tellurides, and free gold, and the other with a wider vein carrying copper sulphides and gold in a quartz gangue. The production of the last few years has been almost wholly from placers and mainly from dredging.

NUMBER OF PRODUCING MINES.

The following table indicates the number of mines producing gold and silver in 1910, divided into placers and deep mines. The placers are those in which gold, the silver in natural alloy with the gold, and in a few instances platinum, are recovered from gravels and sands whether by hand washing, sluicing, "hydraulicking," drifting (in frozen ground or ancient buried river channels), or dredging. The deep mines are those producing gold and silver mainly from underground workings, including those whose ores are valuable chiefly for copper, lead, or zinc, but which contribute precious metals as by-products. In addition to the producing mines here enumerated, many mines were being prospected and developed without making

[1] Ferguson, H. G., The Arroroy mining district: Mineral Resources of the Philippine Islands, Bureau of Science, Manila, 1910, pp. 18–25.

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an output in 1910; and the annual assessment work was done on a very much greater number of old, worked-out, or indefinitely idle mines, once productive, and of mere mining claims, which are not yet "mines."

The enumeration of placer mines is less satisfactory than that of deep mines, because some of the operations are only temporary and because the production is frequently obtained by transitory miners not regularly working placer ground. The unit so far as possible, is, however, as for the deep mines, not the operator, but the claim or group.

Number of producing mines in 1910, by States and Territories.[a]

State or Territory.	Number of mines.		
	Placer.	Deep.	Total.
Alabama	3	3	6
Alaska	650	19	669
Arizona	44	329	373
California	564	515	1,079
Colorado	42	856	898
Georgia	23	8	31
Idaho	262	155	417
Michigan [b]	.....	8	8
Missouri [b]	.....	5	5
Montana	155	423	578
Nevada	68	540	608
New Hampshire, New Jersey, and Pennsylvania	.....	2	2
New Mexico	23	85	108
North Carolina	23	13	36
Oregon	116	64	180
South Carolina	10	2	12
South Dakota	8	18	26
Tennessee	1	4	5
Texas	.....	6	6
Utah	8	175	183
Virginia	1	6	7
Washington	21	55	76
Wyoming	4	8	12
Total	2,026	3,299	5,325

[a] Illinois, Kentucky, Philippines, and Porto Rico not included.
[b] Number of mines contributing to silver production in 1910.

The table shows the number and distribution of producing gold and silver mines in the United States and Alaska. With the exception of (1) some of the Michigan copper mines, (2) of all zinc mines in the Eastern and Central States and a very few in the far West, and (3) of all lead mines of the Central States (except a few in Illinois and southeast Missouri), practically all mines producing copper, lead, and zinc in the United States and Alaska yield gold and silver also. The table therefore, with these exceptions and those of Illinois and Kentucky, is a table of mines producing gold, silver, copper, lead, and zinc in the United States. It also includes certain mines producing oxidized manganese-iron fluxing ores of Colorado, Utah, and elsewhere, whose ores contain precious metals, especially silver, and are sold to western smelters as flux.

Comparisons with corresponding figures for 1909 show a net total decrease of 45 producing mines in 1910. The number of deep mines increased by 116 and the number of placer mines decreased by 161. In 1909 the changes from 1908 were in the same direction, the number

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of deep mines increasing by 319 and the number of placer mines decreasing by 412. For the last five years the number of placer mines reported has been as follows: 2,316 in 1906; 2,586 in 1907; 2,599 in 1908; 2,187 in 1909; and 2,026 in 1910. The enumeration of placer mines presents certain difficulties, as noted above, and it has been especially difficult in Alaska in the earlier years. The figures show increases for three years followed by decreases for the last two years. The number of deep-mine producers, however, has steadily increased, having been 2,114 in 1906; 2,604 in 1907; 2,864 in 1908; 3,183 in 1909; and 3,299 in 1910.

In Alaska the estimate for producing placer mines was 1,000 for 1909 and 650 for 1910, and there were 19 deep mines producing each year. In Arizona the placer producers increased from 25 to 44 and the deep mines from 243 to 329. In California the placer mines increased from 556 to 564, but the deep mines decreased from 571 to 515. In Colorado the placer mines increased from 21 to 42 and the number of producing deep mines decreased from 904 to 856. In Idaho, Nevada, Utah, and Washington both placers and deep mines increased in number in 1910, and in Montana both decreased.

ORE PRODUCTION AND AVERAGE VALUES.

The best index of deep mining is, of course, the tonnage, content, and value of ore mined, rather than the number of mines or of operators. In the next following table is given the ore production, by classes of ore and by States and Territories, of mines producing gold and silver, and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. An ore is generally understood to be worked at a profit for one or more metals. The complex nature of western ores, especially, and the gradations from one well-recognized class to another render essential some fixed measures for the terminology used. The dry or siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious-metal bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made, although an attempt at such further classification will be made in a forthcoming report. The total number of silver mines and the total quantity of true silver ores are both relatively very small. The copper ores include those containing over 2½ per cent of copper, or less than this in the cases of the great disseminated copper deposits of the West and of the Lake Superior ores; the lead ores are those containing 4½ per cent or more of lead, and the zinc ores are those containing 25 per cent or more of zinc, both irrespective of their precious metal content. The mixed ores are combinations of the ones enumerated.

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Ore production in short tons and average extraction value of gold and silver per ton in 1910, by States and Territories.[a]

State or Territory.	Dry or siliceous ores.		Copper ores.		Lead ores.		Zinc ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama, Georgia	23,325	$2.20						
Alaska	1,487,260	2.77	39,365	$1.27				
Arizona	255,391	8.65	3,644,495	.59	6,240	$15.60	7,650	$5.90
California	1,963,296	5.23	716,685	1.94	17,904	6.72		
Colorado	1,957,379	11.65	15,078	27.91	133,323	6.07	82,251	.36
Idaho	115,444	8.57	70,163	3.88	1,566,561	2.27	34,006	.31
Michigan[b]			1,518,000	.117				
Montana	385,067	9.19	4,517,709	1.24	5,951	27.83	169,165	2.23
Nevada	1,258,394	19.51	2,875,490	.21	16,805	23.62	3,038	.96
New Hampshire and Pennsylvania			218,752	.03				
New Mexico	86,917	9.30	55,220	1.11	4,084	2.58	20,944	(c)
North Carolina	12,693	4.42	2,221	2.51				
Oregon	82,064	6.42	68	4.85				
South Carolina	24,153	1.50						
South Dakota	1,523,868	3.58			61	23.47		
Tennessee			552,796	.08				
Texas	21,872	9.18	17	2.41	28	21.75		
Utah	391,568	3.25	5,417,558	.64	329,058	12.32	4,954	.78
Virginia	239	2.78	271	.75				
Washington	56,860	15.63	819	5.06	1,530	1.32		
Wyoming	504	3.50	970	1.63				
Total	9,646,294	8.07	19,145,677	.74	2,081,545	4.44	322,008	1.46
Per cent of tonnage	30.41		60.36		6.56		1.02	

State or Territory.	Copper-lead and copper-lead-zinc ores.		Lead-zinc ores.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.
Alabama, Georgia					23,325
Alaska					1,526,625
Arizona	1,193	$19.23			3,914,969
California					2,697,885
Colorado	2,219	47.48	244,414	$2.20	2,434,664
Idaho					1,786,174
Michigan[b]					1,518,000
Montana	1,524	31.22	30		5,079,446
Nevada	385	17.19	1,663	1.97	3,655,775
New Hampshire and Pennsylvania					218,752
New Mexico	15	40.13	24,685	1.22	191,865
North Carolina					14,914
Oregon					82,132
South Carolina					24,153
South Dakota					1,523,929
Tennessee					552,796
Texas					21,917
Utah	14,982	8.25	231,278	3.33	6,389,398
Virginia					510
Washington					59,209
Wyoming					1,474
Total	20,318	15.11	502,070	2.67	31,717,912
Per cent of tonnage	0.07		1.58		100.00

[a] Illinois, Kentucky, Missouri, Philippines, and Porto Rico not included in this table.
[b] Includes only copper ore yielding precious metals.
[c] 15 ounces in 20,944 tons.

The total quantity of ore treated or sold in 1910 and producing gold and silver was 31,717,912 short tons, against 30,564,557 short tons in 1909. The total output of dry or siliceous ores decreased from 9,755,650 short tons, or 31.92 per cent of the total, in 1909, to 9,646,294 short tons, or 30.41 per cent of the total, in 1910. The average precious metal value per ton, however, increased from $7.65 in 1909 to $8.07 in 1910. The quantity of copper ores increased from 18,152,224 tons,

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or 59.39 per cent of the total output, in 1909, to 19,145,677 tons, or 60.36 per cent, in 1910; but the average gold and silver per ton value dropped from $0.83 in 1909 to $0.74 in 1910. The output of argentiferous lead ores decreased from 2,243,840 tons, or 7.34 per cent, with an average precious metal value per ton of $4.65, in 1909, to 2,081,545 tons, or 6.56 per cent, with a precious metal value of $4.44 in 1910. The production of gold and silver bearing zinc ores increased from 58,173 tons, or 0.19 per cent, in 1909, to 322,008 tons, or 1.02 per cent, in 1910, but decreased in average precious metal value per ton from $3.68 to $1.46. The output of copper-lead and copper-lead-zinc ores decreased from 32,193 tons, or 0.11 per cent, with an average precious metal value per ton of $20.18, in 1909, to 20,318 tons, or 0.07 per cent, and a gold and silver value of $15.11 in 1910. The production of lead-zinc ores, on the other hand, increased from 322,477 tons, or 1.05 per cent, with a gold and silver value of $2.42, in 1909, to 502,070 tons, or 1.58 per cent, with a value of $2.67 in 1910.

The production of dry or siliceous ores increased from 237,078 tons in 1909 to 255,391 tons in 1910 in Arizona; from 1,749,112 to 1,957,379 tons in Colorado; from 1,229,651 to 1,258,394 tons in Nevada; and from 358,116 to 391,568 tons in Utah. The output of this class of ore decreased from 1,496,361 tons to 1,487,260 tons in Alaska; from 2,195,741 to 1,963,296 tons in California; from 1,702,266 to 1,523,868 tons in South Dakota; from 185,734 to 115,444 tons in Idaho, and from 416,329 to 385,067 tons in Montana. The great output of this class of ore is notable in Alaska, California, Colorado, Nevada, and South Dakota, and is mainly from the famous Treadwell, Mother Lode and Grass Valley, Cripple Creek, Goldfield and Tonopah, and Homestake mines, respectively, in these States.

The production of copper ores increased from 1,670,457 tons in 1909 to 2,375,490 tons in 1910 in Nevada, and from 4,216,226 to 5,417,558 tons in Utah. The output decreased in Arizona from 3,741,713 tons to 3,644,495 tons, in California from 840,358 to 716,685 tons, in Montana from 4,965,001 to 4,517,709 tons, and in Tennessee from 576,680 to 552,796 tons. The great output from Utah and Nevada is largely from the disseminated deposits, that of Butte (Montana) from fissure deposits, and that of Michigan from the amygdaloid and conglomerate lodes of the Keweenaw district.

The output of precious metal bearing lead ores increased from 1,466,592 tons to 1,566,561 tons in Idaho, but decreased from 174,483 tons to 133,323 tons in Colorado, and from 480,248 to 329,058 tons in Utah. The production of argentiferous lead-zinc ores increased from 221,192 tons to 244,414 tons in Colorado and from 60,275 to 231,278 tons in Utah. The output of argentiferous zinc ores also increased from 5,014 tons to 82,251 tons in Colorado and from 34,463 to 169,165 tons in Montana.

The average extraction value of precious metals derived from dry or siliceous ores increased in Arizona from $7.31 to $8.65 per ton; in California from $4.86 to $5.23; in Idaho from $7.86 to $8.57; in Montana from $8.11 to $9.19; in Nevada from $16.58 to $19.51 and in New Mexico from $7.99 to $9.30. These are notable changes for the better and indicate in part at least improved metallurgical methods. Decreased average extraction is noted in Colorado from $13.41 to $11.65 per ton and in South Dakota from $3.92 to $3.58 per ton, chiefly due probably to changes in grade of ore treated. In Alaska the recovery was $2.76 per ton in 1909 and $2.77 in 1910.

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The total average extraction value of gold and silver from copper ores increased from $0.48 to $0.59 per ton in Arizona in 1910; from $1.78 to $1.94 in California; from $16.32 to $27.91 in Colorado; and from $0.06 to $0.08 in Tennessee. It decreased from $0.24 to $0.21 in Nevada and from $0.88 to $0.64 in Utah. The average extraction value increased in lead ores from $2.06 to $2.27 per ton in Idaho, and from $5.41 to $6.47 in Colorado. In argentiferous zinc ores and lead-zinc ores decreases were general in 1910.

DISTRIBUTION OF GOLD PRODUCTION OF 1910.

Over 92 per cent of the total gold production of the United States is from the combined contribution of the placers and the deep mines producing dry or siliceous ores. The relative proportions of output from these sources, however, show interesting changes from 1909 to 1910. In the former year the placers supplied 27.26 per cent of the total gold output and the dry or siliceous ores 64.87 per cent; in 1910 the placers supplied 23.76 per cent and the dry or siliceous ores 68.91 per cent. In general this illustrates decreasing relative importance of the placers as a whole, as is to be expected. The proportion of the output from copper ore increased from 5.68 per cent in 1909 to 5.77 per cent in 1910. The relative production from zinc ores also increased from 0.05 per cent to 0.07 per cent and that of lead-zinc ores from 0.19 per cent to 0.29 per cent. The relative output from lead ores, however, decreased from 1.59 per cent in 1909 to 1.18 per cent in 1910, and that from copper-lead and copper-lead-zinc ores from 0.36 to 0.02 per cent.

The following table gives the sources by classes of ore and by States and Territories of the gold output of the United States in 1910, in fine ounces:

Source of gold in 1910 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces.[a]

State or Territory.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.
Alabama	17.27	1,604.89	.....	.....
Alaska	579,765.00	198,601.58	1,764.91	.....
Arizona	1,257.27	95,395.07	52,707.40	1,600.09
California	429,995.46	490,705.36	31,844.68	1,188.91
Colorado	19,130.62	943,220.53	8,961.27	11,719.25
Georgia	880.96	841.29	.....	.....
Idaho	11,733.16	37,605.89	765.80	2,927.95
Montana	27,859.98	115,261.06	31,441.93	4,491.71
Nevada	7,854.70	880,180.93	21,280.87	3,967.07
New Hampshire and Pennsylvania	.....	.....	291.07	.....
New Mexico	1,262.30	20,578.63	1,449.41	12.38
North Carolina	497.34	2,745.77	48.57	.....
Oregon	8,268.50	24,599.75	1.98	.....
South Carolina	100.42	1,753.50	.....	.....
South Dakota	143.77	261,158.77	.....	31.64
Tennessee	24.19	.....	126.40	.....
Texas	.....	3.43	2.51	14.52
Utah	192.53	47,216.85	113,978.49	28,327.58
Virginia	4.36	32.12	6.48	.....
Washington	186.68	87,934.44	5.39	.....
Wyoming	31.64	80.98	42.13	.....
Total	1,089,206.15	3,159,520.84	264,669.29	54,281.10
Value	$22,515,889.00	$65,313,092.00	$5,471,200.00	$1,122,090.00
Per cent of total	23.76	68.91	5.77	1.18

[a] Illinois, Philippines, and Porto Rico not included.

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Sources of gold in 1910 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces—Continued.

State or Territory.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama				1,622.16
Alaska				780,131.49
Arizona	1,289.74	101.01		152,350.58
California				953,734.41
Colorado	591.30	181.96	8,224.00	992,028.93
Georgia				1,722.25
Idaho	26.93			53,059.73
Montana	1,023.17	384.41		180,462.26
Nevada	3.75	22.02	5.71	913,265.05
New Hampshire and Pennsylvania				291.07
New Mexico		2.52	32.02	23,337.26
North Carolina				3,291.68
Oregon				32,870.23
South Carolina				1,853.92
South Dakota				261,334.18
Tennessee				150.59
Texas				20.46
Utah	17.72	154.63	5,164.31	195,052.11
Virginia				42.96
Washington				38,126.51
Wyoming				154.75
Total	2,952.61	846.55	13,426.04	4,584,902.58
Value	$61,086.00	$17,500.00	$277,541.00	$94,778,348.00
Per cent of total	0.07	0.02	0.29	100.00

Placers.—The total value of the gold placer output was $22,515,889 in 1910, against $27,036,705 in 1909. The placer gold output of Alaska was $11,984,806, against $16,252,638 in 1909, the heaviest decrease in gold output from Alaska and from the United States and from the placer production as a whole. The placer gold output of California was $8,888,795 in 1910, against $9,104,433 in 1909. Placer production decreased in 1910 also in Colorado, Idaho, and Oregon, but increased in Montana and Nevada.

Dredging supplied $9,293,106 in 1910, against $8,783,380 in 1909. California produced $7,550,254 from dredges in 1910, against $7,382,950 in 1909. The total production of gold from dredging in California to the end of 1910 has been $40,318,775. In 1910 Alaska produced $800,000, Colorado $344,210, Idaho $91,247, Montana $473,385, and Oregon $34,010. There were 113 dredges in all in operation in 1910, of which 72 were in California, 18 in Alaska, 6 each in Colorado, Idaho, and Oregon, and 5 in Montana. The remainder of the placer output was mainly from drift mining, which is especially important in Alaska and California, and from hydraulic and sluicing placers. There is annually also a small production by hand-washing and a yet smaller output from "dry-washing" operations in the arid regions of the Southwest. Although numerous machines have been on trial for these last-named operations, the total production from this source to date has been small.

Dry and siliceous ores.—In 1910, dry or siliceous ores, including true gold ores, and precious metal bearing ores not classed as copper, lead, or zinc ores, produced $65,313,092 in gold, against an output from this source of $64,341,781 in 1909. States producing over $1,000,000 from these ores in 1910 ranked as follows: Colorado, Nevada, California, South Dakota, Alaska, Montana, and Arizona, or in the same relative order as in 1909. Notably increased output from this source

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in 1910 is recorded from Arizona and Washington and especially from Nevada, and there was an increase also from New Mexico. Decreased production of gold from these ores was reported in 1910 from Alaska, California, Colorado, Georgia, Idaho, Montana, Oregon, South Dakota, and Utah. The falling off was notable in South Dakota.

The siliceous ores are in part free-milling, as in Alaska, California, and Oregon; in part both amalgamating and concentrating, as in many States; and in smaller part straight concentrating ores, as in parts of Colorado and Arizona, or smelting ores. Tailings both from old dumps and from present milling are now largely reworked by concentration and cyanidation. The all-sliming and cyanidation method is of increasing importance, and crushing is now largely by tube as well as by stamp and rotary mills. The loss in tailings from gold mills is constantly being reduced, and the most serious present loss is probably in tailings from concentration plants. The chlorination process is of decreasing relative importance. Smelting is mainly of concentrates, and of siliceous and pyritic ores which are also valuable as fluxes. It is hoped that some exact figures of relative gold production in the United States by amalgamation, cyanidation, and chlorination may be given in forthcoming reports.

Copper ores.—The production of gold from copper ores in 1910 was $5,471,200, against $5,631,885 in 1909. Increases in 1910 in gold output from this source are noted from Alaska, Arizona, Nevada, and New Mexico, and decreases from California, Colorado, Idaho, Montana, and Utah. The States leading in production of gold from copper ores, in order of rank, are Utah and Arizona (each of which produced over $1,000,000 in gold from this source), and California, Montana, and Nevada. The Utah copper ores are notable in this respect. The gold is recovered by electrolytic refining of blister copper obtained in smelting the ores and concentrates.

Lead ores.—The production of gold from lead ores was $1,122,090 in 1910, against $1,577,173 in 1909. The Utah lead ores rank first in total yield of gold, followed by those from Colorado. The remainder of the gold output from this source is chiefly from Montana, Nevada, Idaho, Arizona, and California, in order named. Increases are noted from California, Idaho, and Montana, and decreases from the other States named.

Lead-zinc ores.—Production of gold from lead-zinc ores was $277,541 in 1910, against $188,056 in 1909, and is almost wholly from Colorado and Utah, in both of which States the output from this source increased in 1910.

Zinc ores and mixed ores.—The total gold production from zinc ores was $61,036 in 1910, against $50,582 in 1909; and from copper-lead and copper-lead-zinc ores it was $17,500 in 1910, against $363,765 in 1909. The marked decrease from the mixed ores was from Arizona and Colorado.

DISTRIBUTION OF SILVER PRODUCTION OF 1910.

The mine production of silver from dry or siliceous ores, copper ores, and lead ores combined was 94.06 per cent of the total output in 1910, against 96.24 per cent in 1909. The production from dry or siliceous ores increased from 34.59 per cent to 40.15 per cent of the total, but the output from copper ores decreased from 31.93 per cent to 27.82 per cent, and that from lead ores from 29.72 per cent to

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26.09 per cent. The relative output from zinc ores increased from 0.55 to 1.31 per cent and that from lead-zinc ores from 1.99 to 3.42 per cent. There was little change in the very small relative recoveries from placer gold and from copper-lead and copper-lead-zinc ores.

The following table shows the source of silver production of the United States in 1910, by classes of ore by States:

Source of silver in 1910 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces.[a]

State or Territory.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.
Alabama		268		
Alaska	101,339	30,123	26,388	
Arizona	167	440,126	1,934,363	119,034
California	41,856	257,355	1,363,668	177,206
Colorado	4,954	6,117,719	436,358	1,050,611
Georgia	84	251		
Idaho	2,438	393,795	475,363	6,479,636
Illinois				2,022
Kentucky				84
Michigan			330,500	
Missouri				33,096
Montana	3,097	2,139,465	9,153,590	134,798
Nevada	3,655	11,768,012	107,365	583,282
New Hampshire and Pennsylvania			526	
New Mexico	374	708,762	60,228	19,040
North Carolina	43	456	8,554	
Oregon	1,239	34,204	535	
South Carolina	20	26		
South Dakota	26	117,333		1,441
Tennessee	2		81,237	
Texas		379,402	49	571
Utah	25	548,498	2,036,909	6,428,523
Virginia			128	
Washington	60	194,078	7,475	3,732
Wyoming	2	169	1,307	
Total	159,381	23,125,042	16,024,543	15,028,076
Value	$86,066	$12,487,523	$8,653,253	$8,115,161
Per cent of total	0.28	40.15	27.82	26.09

State or Territory.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama				268
Alaska				157,850
Arizona	34,227	38,611		2,566,528
California				1,840,085
Colorado	32,310	188,146	679,500	8,509,598
Georgia				335
Idaho	18,510			7,369,742
Illinois				2,022
Kentucky				84
Michigan				330,500
Missouri				33,096
Montana	658,516	73,391		12,162,857
Nevada	5,281	11,413	5,863	12,479,871
New Hampshire and Pennsylvania				526
New Mexico	15	1,018	54,550	843,987
North Carolina				9,053
Oregon				35,978
South Carolina				46
South Dakota				118,800
Tennessee				81,239
Texas		300		380,322
Utah	6,510	223,108	1,228,398	10,466,971
Virginia				128
Washington				205,345
Wyoming				1,478
Total	755,369	535,987	1,968,311	57,596,709
Value	$407,899	$289,433	$1,062,888	$31,102,223
Per cent of total	1.31	0.93	3.42	100.00

[a] Philippines and Porto Rico not included in this table.

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Placers.—The output of silver from placers, mainly in Alaska and California, was 159,381 fine ounces in 1910, as against 152,040 ounces in 1909. The recovery is by refining the placer gold.

Dry and siliceous ores.—The output of silver from dry and siliceous ores was 23,125,042 fine ounces in 1910, as against 19,826,890 ounces in 1909. The most notable gain was in Nevada, from 9,456,840 ounces in 1909 to 11,763,012 ounces in 1910. Other increases in output of silver from this source were: In Arizona, from 407,757 ounces to 440,126 ounces; in Colorado, from 5,716,373 to 6,117,719 ounces; in Montana, from 1,660,061 to 2,139,465 ounces; in New Mexico, from 323,962 to 708,762 ounces; in Utah, from 402,313 to 548,498 ounces; and in Washington, from 64,078 to 194,078 ounces. Output of silver from these ores decreased in California from 456,826 to 257,355 ounces, and in Idaho from 715,858 to 393,795 ounces. The production from Texas showed little change. In order of production of silver from this source the States ranked as follows: Nevada, Colorado, Montana, New Mexico, Utah, Arizona, and Texas. With a few notable exceptions, where there are mines producing true silver ores, as in San Bernardino County, Cal., the dry or siliceous ores are gold-silver or silver-gold ores (the latter notable at Tonopah, Nev.). In Colorado the output is largely from Leadville, but also from San Miguel County and from Creede in Mineral County. The largest output of silver from the gold-silver siliceous ores is with the gold by amalgamation and cyanidation, and the metals are separated in refining the gold. Rich ores are usually smelted and the silver is then recovered in the refining of the copper or lead bullion.

Copper ores.—The production of silver from copper ores was 16,024,543 fine ounces in 1910, as against 18,300,705 ounces in 1909, corresponding to a reduced output of copper in 1910, owing chiefly to curtailment at some of the large mines. The silver production from copper ores is from electrolytic refining of blister copper produced by smelting. The copper ores are mainly sulphides, with a greater tonnage containing chalcocite than chalcopyrite, and the great disseminated deposits of Utah, Arizona, Nevada, and New Mexico, in the arid region of the Great Basin, are of constantly increasing importance. These ores are mainly concentrated before smelting. Oxidized copper ores of decreasing relative importance, which are sought for as fluxing ores and commonly smelted crude, still come from the Bisbee and the Tintic districts.

In output of silver from copper ores Montana led with 9,153,590 ounces in 1910, as against 10,281,046 ounces in 1909. Utah followed with 2,036,909 ounces, against 2,500,717 ounces in 1909. Arizona produced 1,934,363 ounces, as against 1,830,998 ounces in 1909, and California 1,363,668 ounces in 1910, as against 1,539,665 in 1909. The decreases in these States are marked, but the production in Colorado also decreased from 1,058,894 to 436,358 ounces, and that in Idaho from 599,331 to 475,363 ounces. The output of Montana is mainly from Butte, that of Utah from Tintic and Bingham, that of California from Shasta County, and that of Arizona from Bisbee and Jerome. Of these the Bingham camp alone represents the deposits of the disseminated type, and the silver output from other copper ores is still chiefly from deep lodes.

Lead ores.—Silver production from argentiferous lead ores was 15,028,076 fine ounces in 1910, as against 17,027,737 ounces in 1909.

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The output from Idaho increased from 5,692,906 ounces in 1909 to 6,479,636 ounces in 1910, while that from Utah decreased from 8,314,766 to 6,423,523 ounces, that from Nevada from 1,415,416 to 583,282 ounces, and that from Colorado from 1,127,589 to 1,050,611 ounces. The output in Idaho is mainly from the Cœur d'Alenes, that in Utah from the Park City and Tintic districts, and that in Colorado from Aspen and Leadville. Although much of this silver production is from argentiferous galena, oxidized silver-lead ores are still mined at Tintic, Aspen, and a few other camps.

Zinc, lead-zinc, and mixed ores.—Argentiferous zinc ores supplied 755,369 fine ounces of silver in 1910, as against 313,948 ounces in 1909 and 37,605 ounces in 1908, the output and the increase being mainly from the Butte district of Montana, where the zinc mining industry has been making rapid strides.

Lead-zinc ores furnished 1,968,311 ounces of silver in 1910, as against 1,141,434 ounces in 1909. Production from this source increased from 399,396 ounces to 1,228,398 ounces in Utah, and from 15,684 to 54,550 ounces in New Mexico, but decreased slightly in Colorado and ceased entirely in Idaho.

Copper-lead and copper-lead-zinc ores supplied 535,987 fine ounces of silver in 1910, as against 549,923 ounces in 1909. The production is mainly from Utah, Colorado, and Montana, the increase being large in Utah and the decrease large in Colorado and Montana in 1910.

DISTRIBUTION OF PRODUCTION OF GOLD AND SILVER BY METHODS OF TREATMENT.

An attempt is made in the following table to summarize the distribution of the gold and silver production of the United States (1) by tonnage of ore treated in gold and silver mills; (2) by tonnage of ore concentrated, with resulting tonnage of concentrates produced; (3) by tonnage of ore smelted crude; and (4) by tonnage of old tailings or slags treated—all with recoverable gold and silver content in fine ounces, and by States.

In reference to the first item it should be remembered that many gold and silver mills employ concentrating apparatus, and the concentrates resulting, those from California, for example, are combined with those from straight concentrating mills in the column "concentrates produced." The gold and silver recovery under this item is mainly by amalgamation and cyanidation. Data for exact figures for recovery separately by amalgamation, cyanidation, and chlorination are in prospect for a forthcoming report.

Under the second item is given the tonnage treated for concentration only, including the large quantities of copper, lead, zinc, and mixed ores, whose concentrates are smelted primarily for these metals, the gold and silver of which are recovered in refining the copper, lead, and zinc. Examples are the copper ores of the disseminated deposits of Bingham, Utah, the ores of Butte, Mont., the lead ores of the Cœur d'Alenes, Idaho, and some of the lead-zinc and mixed ores of Leadville, Colo. The tonnage of concentrates produced and the recoverable metal, as stated above, represent not only the concentrates from these straight concentrating mills, but also those from gold and silver mills. The concentrates are mainly smelted, as stated, but are in some cases treated in gold and silver mills by the processes named.

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The third item covers tonnage and recoverable precious-metal content sent direct to smelters from the mines and in general includes the richer gold, silver, copper, lead, and zinc ores from which gold and silver are eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting.

Under the fourth item are given the quantities of old material, principally slags or tailings, re-treated. These are largely smelted, sometimes mainly for their fluxing values, but increasing quantities of old tailings are now concentrated and cyanided for their gold content, as in the case of Cripple Creek.

Distribution of production of gold and silver in 1910 by methods of treatment.

State or Territory.	Tons of ore, slag, and tailings sold or treated in 1910.	Ore treated at gold and silver mills.			Ore sent to concentrating mills.	Concentrates produced.		
		Short tons.	Gold in bullion.	Silver in bullion.		Short tons.	Gold.	Silver.
			Fine ounces.	Fine ounces.	Short tons.		Fine ounces.	Fine ounces.
Alaska	1,526,625	1,487,260	124,260	16,997	.....	26,012	74,342	13,126
Arizona	3,914,969	178,685	83,746	44,130	1,426,443	254,022	9,956	96,894
California	2,697,885	1,900,556	383,421	145,959	3,497	33,699	95,806	36,797
Colorado	2,521,927	1,455,983	627,880	396,381	464,673	237,342	122,163	2,192,315
Idaho	1,786,174	111,156	32,580	315,128	1,533,862	199,327	5,915	4,421,560
Montana	5,079,446	266,689	67,154	61,199	4,170,114	1,281,319	31,589	8,208,644
Nevada	3,655,775	1,130,750	721,804	6,367,369	2,347,209	233,913	76,692	2,576,815
New Mexico	191,865	67,148	14,221	412,272	61,379	18,298	4,536	255,060
Oregon	82,132	68,841	15,495	6,215	.....	1,988	6,287	3,093
South Dakota	1,523,929	1,516,339	253,206	101,922	.....	11	15	2
Texas	21,917	21,825	2	372,109	.....	113	1	6,189
Utah	6,389,398	263,041	35,209	4,571	5,182,057	300,880	47,792	2,138,728
Washington	59,209	2,089	759	601	.....	23	42	82
Wyoming	1,474	5	22	4	.....	.....	.....	.....
Eastern or Appalachian States	834,450	58,229	6,564	994	218,283	11,045	316	74
Total	30,287,175	8,528,596	2,366,322	8,245,851	15,407,517	2,597,992	475,452	19,949,379

State or Territory.	Crude ore sent to smelter.			Old tailings or slags treated.		
	Short tons.	Gold.	Silver.	Short tons.	Gold.	Silver.
		Fine ounces.	Fine ounces.		Fine ounces.	Fine ounces.
Alaska	39,365	1,765	26,388	.....	.....	.....
Arizona	2,284,726	56,444	2,402,229	25,115	948	23,108
California	741,884	38,821	1,604,618	51,948	5,690	10,855
Colorado	514,008	209,734	5,915,292	87,263	13,121	656
Idaho	131,655	2,764	2,588,431	9,501	68	41,985
Montana	616,596	52,043	3,766,375	26,047	1,689	68,991
Nevada	104,562	100,574	3,380,087	73,254	6,341	151,995
New Mexico	63,338	3,318	176,281	.....	.....	.....
Oregon	1,149	2,300	24,430	12,142	519	1,002
South Dakota	7,589	7,936	16,613	1	34	237
Texas	92	16	1,705	.....	1	319
Utah	896,834	110,147	8,289,042	47,466	1,712	34,605
Washington	57,120	36,939	204,602	.....	.....	.....
Wyoming	1,469	101	1,472	.....	.....	.....
Eastern or Appalachian States	556,038	370	90,322	1,900	200	56
Total	6,016,425	623,272	28,487,837	334,637	30,323	333,809

From the table the tonnage of the Central States, producing relatively small quantities of silver and no gold, has been omitted, as the silver output of these States is from a very small part of the total

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tonnage mined. The tonnages of zinc ores of New Jersey and Virginia are also omitted, as these produce no silver or gold. With the exceptions noted the total tonnage treated or sold, of crude ore and old slags and tailings, that produced gold and silver in 1910, was 30,287,175 short tons. Of this quantity 8,528,596 tons were treated in gold and silver mills, producing 2,366,322 fine ounces of gold and 8,245,851 fine ounces of silver as mill bullion; 15,407,517 tons were sent to straight concentrating mills, producing (with a portion of the tonnage treated in gold and silver mills) 2,597,992 tons of concentrates containing, in addition to copper, lead, or zinc, 475,452 fine ounces of recoverable gold and 19,949,379 fine ounces of silver; 6,016,425 short tons were sent to smelters to be smelted crude and contained 623,272 fine ounces of gold and 28,487,837 ounces of silver; and 334,637 tons were of old slags, tailings, smelter cleanings, etc., sold or treated, and contained 30,323 ounces of gold and 333,809 ounces of silver. The relatively large proportion of gold recovered in the mills and the relatively larger proportion of silver recovered by smelting are notable.

In the table given Utah ranks first in point of total tonnage, the bulk of which was concentrated, and the greater portion of the gold and silver of which was recovered by the smelters, either from concentrates or crude ores. Montana ranks second and Arizona third in tonnage given, with the recovery again mainly by the smelters. In quantity of crude ore sent direct to smelters Arizona ranks first. In quantity of ore treated at gold and silver mills California ranks first, followed in order by South Dakota, Alaska, and Colorado, these being represented, respectively, mainly by the mines and mills of the great Mother Lode, Grass Valley, Homestake, Treadwell, and Cripple Creek.

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COPPER.

By B. S. Butler.

INTRODUCTION.

In the production of metallic copper suitable for commercial purposes three distinct processes are usually required, namely, mining, smelting, and refining. The Lake Superior native copper district is the only important producer where these three processes are not entirely distinct. It is possible, therefore, to ascertain the copper output of the country by collecting statistics from the mines, from the smelters, and from the refineries, and each of these sets of figures has its advantages and its disadvantages. The mine figures have the advantage of giving the most accurate distribution of the production, but are less accurate in total quantity of copper recovered; the smelter figures permit of reasonably accurate distribution and also furnish the actual recovery of copper from the ores treated during the year; the refinery figures furnish the best measure of the copper made available for commercial uses during the year, but at this stage of manufacture the accurate distribution to the State of origin, or even the separation of copper derived from domestic and from foreign sources, is uncertain.

Statistics for 1910 showing the production of each of these stages of manufacture have been collected by the United States Geological Survey, and are presented in the following report.

Since the same material passes through the three processes of manufacture at successive periods, usually requiring two to three months from the time it is taken from the mine before it reaches the stage of refined copper, the year's production as recorded for the different stages does not represent the same materials—that is, the refinery production for the calendar year 1910 represents the mine production from about October 1, 1909, to October 1, 1910. The three sets of figures representing the successive stages of manufacture do not therefore necessarily agree, although they should not differ greatly if the condition of the industry is normal. The mine and the smelter figures will differ by the difference in the quantity of ore, matte, etc., in stock at the beginning and at the end of the year, and by the difference in the quantity of copper reported by the mines and that recovered by the smelters. This difference is due to the fact that considerable copper is recovered from sulphur, lead, zinc, and siliceous ores carrying values in copper so low that the mines do not receive pay for and frequently do not report the copper content

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of the ore, although it is eventually recovered by the smelters. The smelter and refinery figures will differ by the increase or decrease in stock of blister, etc., at the beginning and at the end of the year, and by the loss in refining.

Since the smelter production permits reasonably accurate distribution as to source by States and also gives the actual output of copper, it is adopted in this report as the production of the country. It is made up of the production of blister copper and of furnace-refined or ingot copper of the Lake district.

SUMMARY OF STATISTICS.

The following statistical statement summarizes the copper industry in the United States in 1909 and 1910:

Summary of statistics of the copper industry in the United States in 1909 and 1910.

	1909	1910
Production of copper:		
Smelter output.....pounds..	1,092,951,624	1,080,159,509
Mine production.....do....	1,126,521,126	1,088,237,432
Refinery production of new copper—		
Electrolytic.....do....	778,808,910	782,171,204
Lake.....do....	227,005,923	221,462,984
Casting.....do....	59,750,088	68,260,688
Total domestic.....do....	1,065,564,921	1,071,894,876
Total domestic and foreign.....do....	1,391,021,454	1,422,039,135
Total new and old copper.....do....	1,480,467,686	1,610,000,000
Total ore treated.....short tons..	28,025,092	28,517,556
Copper ore treated.....do....	27,932,618	28,497,123
Average yield of copper.....per cent..	1.98	1.88
Imports.....pounds..	321,801,114	344,435,771
Exports.....do....	682,846,725	708,316,543
Consumption:		
Total new copper.....do....	688,000,000	732,400,000
Total new and old copper.....do....	778,011,473	941,400,000
World's production.....do....	1,873,404,407	1,903,297,008
Value of production in the United States.....	$142,083,711	$137,180,257

Production of copper in the United States in 1909 and 1910.

[Smelter output, in pounds fine.]

	1909	1910		1909	1910
Alaska	4,057,142	4,311,026	Philippine Islands	.....	1,781
Arizona	291,110,298	297,250,538	South Dakota	41,988	43
California	53,568,708	45,760,300	Tennessee	19,207,747	16,691,777
Colorado	11,485,631	9,367,497	Texas	3,456	2,961
Georgia	.....	724	Utah	101,241,114	125,185,455
Idaho	7,096,132	6,877,515	Vermont	.....	1,935
Michigan	227,005,923	221,462,984	Virginia	231,971	105,313
Montana	314,858,291	283,078,473	Washington	120,611	65,021
Nevada	53,849,281	64,494,640	Wyoming	433,672	217,127
New Hampshire	88,944	12,409	Missouri and unapportioned	2,159,636	603,570
New Mexico	5,031,136	3,784,609			
North Carolina	120,451	181,263	Total	1,092,951,624	1,080,159,509
Oregon	245,403	22,022			
Pennsylvania	994,089	740,626			

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GENERAL CONDITION OF INDUSTRY.

The year 1910, like the preceding year, was one of prosperity for the copper industry. The smelter output was but slightly less than that of 1909 and exceeded that of any year but 1909. The output of the refineries was the largest in the history of the industry.

The output from both mines and smelters for the year would normally have exceeded that of 1909, as both the mines and the reduction plants were in a position to make a record output; but toward the middle of the year it became evident that the production of copper was exceeding the consumption, and a general policy of curtailment was inaugurated by the mining companies. This curtailment, however, did not affect the refinery output notably until after the close of the year.

No large new producers were added during the year, though a few companies that had been idle in 1909 made a small production. The development of ore and the preparation for production were actively carried on by several companies that will enter the producing list in 1911 and later. Among the more important of these were the companies in the Miami and Ray districts, Arizona; the Santa Rita district, New Mexico; the Yerington district, Nevada; the Lake Superior district, Michigan; and the Copper River district, Alaska.

Both domestic consumption and export of refined copper were the largest in the history of the industry, but were not sufficient to equal the producing capacity of the country. The most essential factor to the prosperity of the industry is an increase in the consumption of refined copper. This is necessary, not that the price may be advanced materially, but in order that the additional copper supplied by the new producers, both domestic and foreign, may be absorbed and yet the old companies may operate their plants at full capacity. Most of the large producers of the country can make copper at a substantial profit at the prices prevailing for the last three years if they are able to operate their plants at maximum capacity and thus avail themselves of every opportunity to reduce the cost of production. It is evident that if copper is to be produced at the minimum cost there must be an increase in consumption that will permit all producers to operate at full capacity, or a part of the plants must close in order that the remainder may operate at maximum capacity and lowest cost. The closing of a part of the plants, however, is not feasible without a general merger of the copper industry, since many of the higher cost producers, the ones that would normally be closed, are operating old mines with extensive developments that must be worked or abandoned, as the cost of pumping, repairs, etc., with the mine idle would be prohibitive.

The consumption of copper has been on the increase, and it is probable that with the continuance of the relatively low price it will be used for some purposes, such as construction, etc., far more extensively than it has been in the past. Any important increase in the use of the metal outside of the industries for which it is essential must depend, however, upon a relatively low cost. It therefore appears that a marked increase in the price of copper can not be expected unless there is a curtailment of production, as the uses for which the metal is now employed do not demand a quantity equal to the maximum capacity of the producing plants. The continuance of a

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relatively low price, however, should lead to increased uses of the metal and permit a larger production at lower cost, and possibly with as great or greater profit to the producers.

The average price of copper for 1910, which was 12.7 cents per pound, was the lowest since 1902, but was not far below the average for the last 25 years, as may be seen by referring to the diagram (fig. 1) showing the variations in price since 1860.

The cost of production in 1910 was probably as low as it has been in recent years, and it would have been still lower if the plants had been operated at maximum capacity. One of the most striking features of the industry during the last three years has been the continued decrease in the cost of production. Companies whose copper cost in excess of 15 cents per pound in 1907 produced at a profit in 1910, with copper averaging 12.7 cents per pound, and the new companies that have become producers in the last three years report low cost of production.

Considerable copper was produced at a loss during the year, but such was also the case in 1906 and 1907, when the average price per pound was 19 and 20 cents, respectively. Most of the large producing companies were able to show a profit with a curtailed output; many of them had in preparation or already in operation additional economies which, with a maximum output, will result in lowering the cost of production still further.

The most important event in the copper industry for the last two years has been the consolidation of companies in several of the large copper districts. Among the more important of these consolidations may be mentioned that of the Amalgamated interests and the Clark copper properties of Butte, Mont., under the Anaconda Copper Mining Co.; in the same district, the East Butte Copper Co. absorbed the interests of the Pittsburg & Montana Copper Co. and the Pittsmont smelter. In the Lake Superior district, Michigan, the Calumet & Hecla Mining Co. purchased the Bigelow interests, and a consolidation of most of the companies affiliated with the Calumet & Hecla Mining Co. was under consideration at the close of 1910. In the Bingham district, Utah, the Utah Copper Co. absorbed the Boston Consolidated Copper Co. and later acquired other mineral land; it also acquired a controlling interest in the Nevada Consolidated Copper Co. In the Ely district, Nevada, the Nevada Consolidated Copper Co. absorbed the Cumberland-Ely Copper Co. and the Steptoe Valley Smelting Co., and, as already stated, a controlling interest in the Nevada Consolidated Copper Co. was acquired by the Utah Copper Co. In the Bisbee district, Arizona, a merger of the Calumet & Arizona Copper Co. and the Superior & Pittsburg Copper Co. was effected early in 1911. In the Ray district, Arizona, the Ray Consolidated Copper Co. acquired the property of the Gila Copper Co., and another merger in the district is contemplated. Other mergers of less importance have been effected in the different districts and still others are under consideration.

Most of these mergers have been brought about with the idea of increasing the efficiency of operation and of lowering the cost of production, and these ends have generally been attained. The copper output of the country is now controlled by a few groups of interests and in view of the adverse decisions rendered by the United States Supreme Court in the cases of the Standard Oil Co. and the

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American Tobacco Co., it seems doubtful if further centralization of these groups will be attempted, though such a result is desired in some quarters.

A factor of increasing importance to the copper industry is the output of secondary copper. During 1910 the quantity of copper that had been used and returned to the industry in the form of old scrap was equal to about 17 per cent of the total consumption of new copper in the United States and was exceeded in amount by the individual output of new copper by only three States, Arizona, Montana, and Michigan. It is to be expected that there will be an increase in the quantity of copper recovered from scrap that will have a general relation to the increase in consumption in the past.

GEOLOGICAL CLASSIFICATION OF COPPER DEPOSITS.

BASIS OF CLASSIFICATION.

The geological classification of copper deposits is of interest as well as the metallurgical classification. From a statistical standpoint, such a classification is somewhat difficult for the reason that in a single district two or more types may occur and in some instances the amount of copper derived from each has not been recorded. The approximate amount derived from the several types can, however, usually be ascertained.

It is apparent that from a statistical standpoint only broad groups can be recognized as the data are not available for ascertaining the output from types of minor commercial importance, although they may be of great scientific interest.

A classification may be made on the basis of the geologic age of the deposits which is usually the same for all deposits in a given district, which method groups together deposits differing greatly in mineralogical character and geologic occurrence; or, on the other hand, a classification may be based on geologic occurrence and mineralogical character, by which method deposits of widely separated ages are thrown into the same group.

CLASSIFICATION ACCORDING TO GEOLOGIC AGE.

Lindgren[1] has given an age classification of metalliferous ores to which the copper deposits of the United States of known age may be readily referred, although unfortunately there are some of the deposits whose age has not been positively determined.

In varying quantity copper minerals are of widespread and general occurrence both in geographic distribution and in geologic age. It is doubtful if there has been an important period of deposition of metallic minerals, with the exception of iron ores, in which copper minerals have not been deposited to a greater or less extent. In spite of this very universal distribution of the metal, all the deposits of known age that have made important contributions to the country's output can be referred to four periods which in general correspond to periods of igneous activity.

Pre-Cambrian periods.—The pre-Cambrian, covering as it does a very long portion of geologic time, probably includes deposits formed

[1] Lindgren, Waldemar, Metallogenetic epochs, Econ. Geology, vol. 4, 1909, p. 409.

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at widely separated times and certainly of wide geographic distribution and of very different character. The important deposits of this age that have been developed to the present time are, however, few in number. The larger producers have been the Lake Superior district of Michigan, the Jerome district of Arizona, and the Encampment district of Wyoming; some lesser deposits in the West and possibly some of the Appalachian deposits should be classed with them. Deposits of this age have yielded approximately 35 per cent of the total output of the country.

Paleozoic era.—The deposits of this era are confined to the Appalachian region. They were formerly considered to be of pre-Cambrian age, but it is now known that several of the Appalachian deposits occur in metamorphosed sediments of early or middle Paleozoic age, and it is probable that the same age will be shown for the inclosing rock of more of them. The time in the Paleozoic when the deposits were formed is somewhat uncertain. Some of them have been described by geologists as being formed before the great period of regional metamorphism which is believed to have occurred in the late Paleozoic; other investigators in studying other deposits have found that the ores were formed after the period of metamorphism. From these descriptions one is led to the conclusion that deposition of copper ore both preceded the regional metamorphism and also followed it. As the data are not now available for a separation of these depositions, they will be considered together—and, indeed, it may be found that most of the deposits were formed during the period of metamorphism. The most important production has been made from the Ducktown district of Tennessee, the Great Gossan lead of Virginia and North Carolina, the Virgilina district of Virginia and North Carolina, and the Ely district of Vermont. Deposits of this age have yielded between 1.5 and 2 per cent of the output of the country.

Mesozoic era.—The third important period of copper deposition occurred in the Mesozoic era, preceding the main deposition of Cretaceous sediments and probably at about the close of the Jurassic or in the early Cretaceous. These deposits are associated with the great masses of monzonitic and dioritic intrusives that extend through the far Western States from British Columbia on the north to Mexico on the south.

Among the more important of these deposits are those of the Shasta district and the "Foothills" district of California, together with numerous districts of Idaho, eastern Washington, and western Nevada, which have not made important production, and the deposits in Alaska. To this general period are assigned the deposits of the Bisbee district, Arizona. Ransome considers that the deposits at Globe, Ariz., are probably of this age, though the field evidence is not conclusive and they may prove to be of the same age as the very similar deposits at Morenci, Ariz., and Santa Rita, N. Mex. It is probable that the deposits of the Ray district and possibly of the Silverbell district, Arizona, will prove to be of the same age as the deposits at Globe. The deposits of the Ely district, Nevada, may be included with these, though it seems quite as probable that they will prove to be of later age.

If the deposits enumerated above are correctly assigned, the output from ores of this age amounts to about 15 per cent of the total.

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Tertiary period.—The fourth important period of copper deposition occurred in Tertiary time and was associated with the extensive granitic and monzonitic intrusions in the Rocky Mountain and eastern Great Basin regions extending from Montana on the north to Mexico on the south. The exact age of these intrusions and the associated ore deposits can not always be fixed, but the intrusives cut Cretaceous rocks and in some instances Miocene rocks, and it is probable that the deposits are from early to middle Tertiary in age.

To this period are assigned the deposits of Butte, Mont., of the Morenci-Metcalf district, Arizona, of the Santa Rita district, New Mexico, and probably the deposits of the Bingham and Frisco districts, Utah, together with many deposits of mixed lead-silver-copper ores in Colorado, Utah, and New Mexico that have yielded considerable copper. If the age assigned to the deposits included in this period is correct, ores of this age have yielded about 46 per cent of the total output of the country, and so far as indicated by past and present production it was the most important of the epochs of copper deposition.

Other periods.—In addition to these deposits and periods mentioned there are deposits along the Pacific coast associated with basic igneous rocks of early Mesozoic age. These deposits have not yielded important quantities of copper. In the east the copper deposits associated with the Triassic traps may be mentioned, though the copper derived from them is unimportant. There is a widespread occurrence of what Lindgren has designated "Cretaceous and later concentrations in sedimentary rocks." Deposits of this character occur largely in the "Red Beds" in Arizona, New Mexico, Utah, Colorado, and Texas, and although they have been of little commercial importance in the past there is a possibility of their proving a source of production at some future time.

A little copper has been produced from deposits of late Tertiary age in the Great Basin, but deposits of this age have been of small importance as copper producers within the United States.

CLASSIFICATION ACCORDING TO OCCURRENCE.

From the standpoint of mineral composition and geologic occurrence, the copper deposits may be grouped into six principal classes and the approximate amount derived from each group may be ascertained. In a general way, this grouping also classifies the ores according to the metallurgical treatment to which they are best adapted.

In a classification of this kind that is adapted to a general statistical treatment, it is apparent that too fine distinctions can not be drawn, since the necessary data are not available, and in some districts where copper has been derived from more than one type of deposit it is not possible to obtain exact figures of the output of each. Moreover, even in a very general classification, there is uncertainty in the case of some deposits as to which type they should be assigned.

The following grouping is presented as of interest from a statistical standpoint but is not suggested as an adequate classification of copper ores where data are available for greater refinement:

Lenticular deposits in schistose and igneous rocks.—Under this head are considered deposits whose primary mineralization consisted mainly of sulphide of iron, copper, and zinc, replacing schistose rocks.

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The schistosity may be either the result of regional metamorphism or of the local shearing of igneous rocks. This class of deposit usually has a more or less lenticular form. The primary ores are generally a rather low-grade smelting ore but are susceptible of cheap mining and metallurgical treatment. In many instances the upper part of these deposits contain a zone of enriched sulphides. To this type may be referred the deposits of the Jerome district, Arizona; the "Foothill" and Shasta County districts, California; the Ducktown district, Tennessee; many smaller deposits in the Appalachian region, including deposits in New Hampshire, Vermont, Virginia, Alabama, and Georgia, and the deposits of the Prince William Sound district, Alaska. The output from this type of deposit has been about 8.5 per cent of the total from the country; in 1910 it was about 9.5 per cent.

Native copper in volcanic flows.—Under this type are grouped deposits in which the copper occurs native in irregular ore shoots in certain beds of volcanic or interbedded volcanic and sedimentary rocks. The ores are nearly all of a concentrating grade, the metal resulting from the concentration being subjected to a special refining process. The Lake Superior district, Michigan, is the only one of this type that has made important production, though similar deposits occur in Pennsylvania, Maryland, New Jersey, and Alaska. The output from this type is essentially that of the Lake Superior district. It has contributed 31.1 per cent of the total output and 20.5 per cent of the production in 1910.

Replacement deposits in sedimentary rocks.—Under this heading are included what are commonly known as contact deposits and deposits formed by the replacement of sediments along fissures. The primary mineralization in this type consists of iron and copper sulphides, together with varying amounts of other sulphides usually replacing limestone or other highly calcareous rocks. Secondary alteration has frequently been extensive in these deposits and much of the copper has been derived from oxidized ores. Most of the ores are of smelting grade. Some of the oxidized ores carry high copper values, and the primary sulphide ores, though relatively low in copper content, are cheaply treated. To this type of deposit may be referred the output of the Bisbee, Globe, and Silverbell districts, and part of the Morenci-Metcalf district, Arizona; part of the production from Bingham, Utah; Santa Rita, N. Mex.; Ely, Nev.; southeastern Alaska, and many smaller districts. To this type also belongs the output from many lead-silver districts in which copper is of minor importance. Among these are Leadville, Colo., Tintic and Park City, Utah, and many others.

The output from this type of ore has been approximately 18 per cent of the total and about 22.5 per cent of the production in 1910.

Disseminated deposits.—Under this type are considered deposits in which the ore minerals occur in small veins or grains disseminated through altered igneous, schistose, or sedimentary rocks. This includes what are frequently referred to as "porphyry ores." The term disseminated is preferable, since many of the ores of this type do not occur in porphyritic rocks.

The primary mineralization commonly consists of pyrite and chalcopyrite with varying quantities of other sulphides. The deposits have usually undergone secondary sulphide enrichment, the copper content of the minerals near the surface being taken in solution and rede-

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posited, usually as chalcocite, on the sulphides lower down. In some instances deposits of this type that have not been enriched are worked, and in still others native copper and cuprite are among the important ore minerals. The ore is usually low-grade concentrating ore but is cheaply mined and milled.

Any separation of this type from that of fissure vein deposits must be purely arbitrary, but it seems desirable to make such a separation. The principal deposits of this type are those of the Bingham and Frisco districts, Utah; Ely district, Nevada; Morenci-Metcalf, Miami, and Ray districts, Arizona; Santa Rita, N. Mex., and others that may prove of future importance. The output from this type of deposit, which has been produced largely during the last five years, is approximately 5.5 per cent of the total and about 20 per cent of the production in 1910.

Fissure vein deposits.—Under this type are included deposits formed in fissure veins and as a replacement along such veins. As already stated, there is no sharp line between this type and that of the disseminated deposits. In the case of the principal deposits of this type, those at Butte, Mont., much of the ore is of a smelting grade, and there are other differences that make it desirable to keep it separate from the disseminated deposits. The primary mineralization of this class consists of sulphides of iron, copper, and zinc in varying amounts, with small amounts of other sulphides filling fissures and replacing the wall rocks. Secondary enrichment in this type as in the preceding has been important in producing the commercial ore. The ores are of both smelting and concentrating grades.

The great deposit of this type is that at Butte, Mont., though smaller deposits occur in many places in the West and to some extent in the Appalachian region. The output from this type is approximately 35 per cent of the total and about 26.5 per cent of the production in 1910.

Disseminated deposits in sedimentary rocks.—To the classes named should be added the disseminated deposits in little altered or unaltered sedimentary rocks, usually referred to as the "Red Beds" deposits. In this class the primary mineralization ordinarily consists of chalcocite disseminated through sandstones, shale, and conglomerate. This may be partly or entirely altered to carbonates, oxides, and silicates. This type has not yielded important amounts of copper in this country, but the deposits are numerous, especially in Texas, New Mexico, Arizona, Colorado, and Utah, and they may prove of commercial importance at some future time.

PRODUCTION.

SMELTER AND MINE PRODUCTION.

GENERAL STATEMENT.

The production of copper in 1910 by smelters from copper-bearing materials from the United States was 1,080,159,509 pounds, valued at $137,180,257,[1] as compared with 1,092,951,624 pounds, valued at $142,083,711, in 1909. The production for 1910 was surpassed by the record production of 1909 only, and falls short of the 1909 production by 12,792,115 pounds, or 1.2 per cent.

[1] For discussion of prices see section on prices on a subsequent page.

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The yearly production of copper in the United States from 1845 to 1910, inclusive, together with the actual and relative changes from each preceding year, is shown in the following table:

Magnitude and growth of copper production in the United States from 1845 to 1910, inclusive.

Year.	Production.	Increase.		Average annual increase by decades.	
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
1845	224,000				
1846	336,000	112,000	50.0		
1847	672,000	336,000	100.0		
1848	1,120,000	448,000	67.0	246,400	50.0
1849	1,568,000	448,000	40.0		
1850	1,456,000	a 112,000	a 7.1		
1851	2,016,000	560,000	38.4		
1852	2,464,000	448,000	22.2		
1853	4,480,000	2,016,000	81.8		
1854	5,040,000	560,000	12.5		
1855	6,720,000	1,730,000	33.3		
1856	8,960,000	2,240,000	33.3	1,472,200	28.5
1857	10,752,000	1,792,000	20.0		
1858	12,320,000	1,568,000	14.6		
1859	14,112,000	1,792,000	14.5		
1860	16,128,000	2,016,000	14.3		
1861	16,800,000	672,000	4.1		
1862	21,160,000	4,360,000	26.0		
1863	19,040,000	a 2,120,000	10.0		
1864	17,920,000	a 1,120,000	a 5.9		
1865	19,040,000	1,120,000	6.3		
1866	19,936,000	896,000	4.7	1,209,600	6.2
1867	22,400,000	2,464,000	12.3		
1868	25,984,000	3,584,000	16.0		
1869	28,000,000	2,016,000	7.7		
1870	28,224,000	224,000	.8		
1871	29,120,000	896,000	3.2		
1872	28,000,000	a 1,120,000	a 3.8		
1873	34,720,000	6,720,000	24.0		
1874	39,200,000	4,480,000	12.9		
1875	40,320,000	1,120,000	2.9	3,225,600	8.2
1876	42,560,000	2,240,000	5.6		
1877	47,040,000	4,480,000	10.5		
1878	48,160,000	1,120,000	2.4		
1879	51,520,000	3,360,000	7.0		
1880	60,480,000	8,960,000	17.4		
1881	71,680,000	11,200,000	18.5		
1882	90,646,232	8,966,232	12.5		
1883	115,526,453	24,886,221	27.4		
1884	144,946,453	29,420,600	25.5		
1885	165,875,766	20,929,113	14.4		
1886	156,735,381	a 9,140,385	a 5.5	18,928,949	14.8
1887	180,920,524	24,185,143	15.4		
1888	226,361,466	45,440,942	25.0		
1889	226,775,962	414,496	.2		
1890	259,763,092	32,987,130	14.5		
1891	284,121,764	24,358,672	9.4		
1892	344,998,679	60,876,915	21.4		
1893	329,354,398	a 15,644,281	a 4.5		
1894	354,188,374	24,833,976	7.5		
1895	380,613,404	26,425,030	7.4		
1896	460,061,430	79,448,026	20.0	34,635,407	9.4
1897	494,078,274	34,016,844	7.4		
1898	526,512,987	32,434,713	6.6		
1899	568,666,921	42,153,934	8.0		
1900	606,117,166	37,450,245	6.6		
1901	602,072,519	a 4,044,647	a .7		
1902	659,508,644	57,436,125	9.5		
1903	698,044,517	38,535,873	5.8		
1904	812,537,267	114,492,750	16.4		
1905	901,907,843	89,370,576	11.0		
1906	917,805,682	a 15,897,839	1.7	47,404,234	6.1
1907	868,996,491	a 48,809,191	a 5.3		
1908	942,570,721	73,574,230	8.4		
1909	1,092,951,624	150,380,903	15.9		
1910	1,080,159,309	a 12,792,115	a 1.2		
Total	15,292,491,343				

a Decrease.

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The figures, except for 1910, are taken from the previous volumes of Mineral Resources of the United States. Statistics from 1882 to 1910, inclusive, are based on the returns to the United States Geological Survey by the copper-producing companies. Figures for the years prior to 1882 were compiled by the survey from the best sources available. Reliable figures for years previous to 1845 are not obtainable. The year 1845, however, marks the entrance of the Lake Superior district into the ranks of producers and is really the beginning of important production of copper in this country. The industry has shown a steady and, since 1880 when Arizona and Montana became important producers, a very rapid growth. The rate

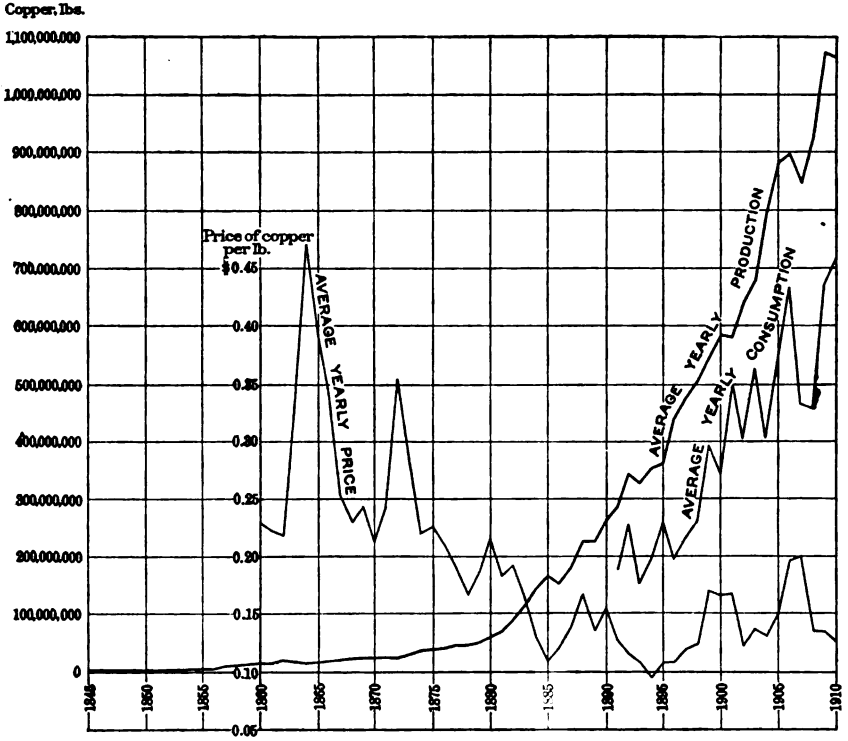

FIGURE 1.—Curve showing production of copper in the United States, 1845–1910.

of increase is well shown by the curve showing production from 1845 to 1910 (fig. 1).

Only five times since 1880 has the annual production shown a decrease from that of the preceding year and in every instance the decrease has been slight and has been more than recovered the following year. The years showing a decrease are 1886, 1893, 1901, 1907, and 1910. At several other times the increase has been slight. In most instances where there has been a decrease it may be attributed to a general condition of financial and business depression which has resulted in a decrease in the demand for copper and other materials necessary to the expansion of industries. In two instances a slight decrease appears to have been due to the fact that the producing capacity of the country had been increased out of proportion to the

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demand for domestic consumption and export and a temporary curtailment in production became necessary to permit the absorption of accumulated stocks. This, coupled with attempts at artificial control of prices, appears to have been the case in 1886 and also in 1901. The decreases in 1893 and in 1907, which were the most pronounced in the history of the industry, were, of course, due to the widespread condition of financial and business depression of those years. The decrease in production in 1910 can be attributed to the great increase in the producing capacity of this and other countries during the last few years, which has outstripped the normal growth in consumption; though for the last two years both domestic consumption and exports have been the largest in the history of the industry. This excessive production resulted in 1910 in the accumulation of large stocks of copper in various stages of manufacture, which it was found necessary to reduce by curtailing the current production. With the absorption of this excess a continued increase in production is to be expected.

SMELTER RETURNS.

The figures of smelter production for 1910 are based on returns made confidentially to the Geological Survey by all known smelting companies handling copper-bearing materials from the United States. To all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries to secure the accurate distribution of the output, sincere thanks are extended. The following list gives the names of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1910. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters can be found in the reports on those metals.

Copper smelting plants that treated materials from the United States in 1910.

Location.	Company.	Final copper product.
UNITED STATES.		
Arizona:		
Clifton	Arizona Copper Co	Blister.
Do	Shannon Copper Co	Do.
Douglas	Calumet and Arizona Mining Co	Do.
Do	Copper Queen Consolidated Mining Co	Do.
Globe	Old Dominion Copper Mining & Smelting Co	Do.
Humboldt	Consolidated Arizona Smelting Co	Do.
Jerome	United Verde Copper Co	Do.
Johnson	Arizona United Mining Co	Matte.
Morenci	Detroit Copper Mining Co	Blister.
Sasco	Southern Arizona Smelting Co	Do.
Swansea	Clara Consolidated Gold & Copper Co	Do.
California:		
Campo Seco	Penn Chemical Works	Matte.
Winthrop	Bully Hill Copper Mining & Smelting Co	Do.
Coram	First National Copper Co	Blister.
Kennett	Mammoth Copper Mining Co	Do.
Martinez	Mountain Copper Co	Do.
Do	General Chemical Co. of California	Matte.
Needles	Needles Smelting & Refining Co	Do.
Colorado:		
Denver	Boston & Colorado Smelting Co	Do.
Utah Junction	Modern Smelting & Refining Co	Do.
Maryland: Baltimore	Baltimore Copper Smelting & Rolling Co. [a]	Electrolytic.

[a] Subsidiary of American Smelters Securities Co.

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Copper smelting plants that treated materials from the United States in 1910—Continued.

Location.	Company.	Final copper product.
UNITED STATES—continued.		
Michigan:		
Hancock	Lake Superior Smelting Co	Anodes and lake.
Do.	Quincy Mining Co	Do.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Mining Co	Do.
Montana:		
Anaconda	Washoe Copper Co	Blister.
Butte	Colusa-Parrot Mining & Smelting Co	Do.
Do.	East Butte Copper Mining Co	Do.
Great Falls	Boston & Montana Consolidated Copper & Silver Mining Co.	Blister and electrolytic.
Nebraska: Omaha	American Smelting & Refining Co	Blister.
Nevada: McGill	Steptoe Valley Mining & Smelting Co	Do.
New Jersey: [a]		
Chrome	United States Metals Refining Co	Electrolytic and casting.
Maurer	American Smelting & Refining Co	Electrolytic.
Newark	Balbach Smelting & Refining Co	Electrolytic and casting.
Perth Amboy	Raritan Copper Works	Electrolytic.
New York:		
Black Rock	Buffalo Smelting Works	Lake and electrolytic.
Laurel Hill	Nichols Copper Co	Electrolytic and casting.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Sulphur, Copper, & Iron Co. (Ltd.).	Matte.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Bingham	Yampa Smelting Co	Blister and matte.
Garfield	Garfield Smelting Co. [b]	Do.
International	International Smelting & Refining Co	Do.
Virginia: West Norfolk	Virginia Smelting Co	Matte.
Washington:		
Northport	Northport Smelting & Refining Co	Do.
Tacoma	Tacoma Smelting Co. [b]	Blister.
CANADA.		
British Columbia:		
Ladysmith	Tyee Copper Co. (Ltd.)	Matte.
Grand Forks	Granby Consolidated Mining, Smelting & Power Co.	Blister.
MEXICO.		
Aguas Calientes: Aguas Calientes.	American Smelting & Refining Co	Do.

[a] This list does not include a smelter in New Jersey and one in Pennsylvania, both of which make blister from material solely of foreign origin.
[b] Subsidiary of American Smelters Securities Co.

During the year 48 copper smelting and refining plants treated material from the United States. Of these, 45 were domestic plants and 3 were foreign, 2 located in British Columbia and 1 in Mexico. Three plants produced in 1910 that were not operated in 1909, namely, the Clara Consolidated Gold & Copper Co., at Swansea, Ariz.; the Consolidated Arizona Smelting Co., at Humboldt, Ariz.; and the International Smelting & Refining Co., at International, Utah. Six small plants that were operated in 1909 were not active in 1910, making a decrease of three in the number of plants active in 1910.

The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. In the case of blister copper the figures represent the fine copper content. Some casting copper is produced direct from ore and matte and this is included in the smelter production.

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The following table shows approximately the production of blister copper from different sections. Smelters that produced only matte are not included in this distribution:

Production of copper in 1910, apportioned according to locality in which smelted to blister, in pounds.

Locality.	Domestic.	Foreign.	Total.
Arizona	295,107,256	22,717,800	317,825,056
Montana	288,625,834	.....	288,625,834
Utah and Nevada	185,717,042	.....	185,717,042
California and Washington	44,599,966	13,189,617	57,789,583
All others	257,853,412	58,877,637	316,731,049
Total by domestic plants	1,071,903,510	94,785,054	1,166,688,564
Total by foreign plants from domestic ore and matte	8,255,999	.....	.....
Grand total from domestic ores	1,080,159,509	.....	.....

As will be seen by comparing this table with the table showing the production by States and districts, ore, with few exceptions, is reduced to blister copper before being shipped from the district. The exceptions in the case of important producing States are Michigan and Colorado. In the case of Michigan the shipping product is high-grade concentrate transported by Lake boats to Buffalo at a low cost; in the case of Colorado the copper is largely produced in lead furnaces and is shipped to Omaha for conversion. Considerable matte produced in California is shipped to the east for conversion.

Arizona treated considerable Mexican ore, and ore and matte from British Columbia were treated in this country. Considerable matte from the United States was smelted in Mexico, and ore from the United States was smelted in British Columbia and returned to this country. A large tonnage of ore and matte from foreign sources was treated by the seaboard smelters.

During 1910 matte smelters produced a total of about 41,250,000 pounds of copper, as compared with 45,100,000 pounds produced in 1909. In most instances the product of these plants is shipped to near-by blister smelters for conversion.

MINE RETURNS.

The figures of mine production are based on reports furnished to the United States Geological Survey by all mines producing copper in 1910. These mines reported 1,088,237,432 pounds of copper, or 8,077,923 pounds more than the smelters. The mines and smelters of the large copper producers are, with few exceptions, under the same management and their production is thought to be reported on the same basis. In the case of mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion there is likely to be considerable discrepancy, as the mines may report a considerable quantity that has not reached the stage of blister by the close of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters the following year. This discrepancy is more pronounced if a marked curtailment of production occurs at the beginning or at the close of the year, so that there is not the bal-

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ance of overlap that occurs if the industry is in normal condition throughout the year. A number of operators report the copper in their ores and concentrates on the basis of assay content, in which case it exceeds the smelter recovery from the same material by the amount lost in smelting. Considerable copper is recovered by the smelters from ores that are treated primarily for other metals, the copper content being so low that it is not paid for, and consequently is not always reported by the mines.

The following table shows the output of copper from domestic ores for the last five years as reported by the mines, smelters, and refineries:

Production of copper from domestic ores as reported by the mines, the smelters, and the refineries, 1906–1910, in pounds.

Year.	Mine.	Smelter.	Refinery.
1906	916,971,387	917,805,682	887,682,387
1907	847,151,015	868,996,491	784,271,427
1908	956,840,578	942,570,721	919,111,414
1909	1,126,521,126	1,092,951,624	1,065,564,921
1910	1,088,237,432	1,080,159,509	1,071,894,876
Total	4,935,721,538	4,902,484,025	4,728,535,005

As shown by this table, in the period of five years the quantity of copper reported by the mines exceeded that reported by the smelters by 33,237,513 pounds, or 0.71 per cent. This difference can be accounted for very largely if not entirely by an increase in stocks of ore and concentrates at the smelting plants. At the beginning of the period there was an urgent demand for copper, and the smelters and refineries were turning out the final product as rapidly as possible, only such stocks being carried as were actually necessary. At the close of the period the demand for refined copper was much less active, and many of the smelting companies were carrying considerable reserve stocks of ore and concentrates.

The difference between the smelter and the refinery production is accounted for entirely by an increase in the stocks of blister copper plus the copper content of bluestone produced and the loss in refining.

It appears that although theoretically the output reported by the mines should be considerably in excess of that reported by the smelters, this difference in the last five years has been nearly balanced by the copper recovered from lead, zinc, gold, silver, and sulphur ores which carry copper values so low that they are not paid for and consequently have not usually been reported by the mines.

PRODUCTION BY STATES.

Twenty-four States and Territories contributed to the copper production of 1910. The following table shows the mine and the smelter output of individual States for 1909 and 1910.

According to smelter returns, the three leading States, Arizona, Montana, and Michigan, produced 74 per cent of the total output of 1910, as compared with 76 per cent in 1909; the six leading States, including Utah, Nevada, and California, produced over 96 per cent of the total output in 1910, as compared with over 95 per cent in 1909.

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Production of copper by smelter returns in 1909 and 1910, compared with mine returns for same years, by States, in pounds.

State.	1910				1909	
	Production.				Production.	
	Rank.	Percentage of total.	Smelter returns.	Mine returns.	Smelter returns.	Mine returns.
Alaska	10	0.40	4,311,026	4,241,689	4,057,142	4,124,705
Arizona	1	27.52	297,250,538	297,491,151	291,110,298	303,899,461
California	6	4.23	45,760,200	48,700,756	53,568,708	57,288,281
Colorado	8	.86	9,307,497	8,359,535	11,485,631	10,922,046
Georgia	23	.....	724	.....	.....	.....
Idaho	9	.64	6,877,515	7,037,292	7,096,132	9,115,489
Michigan	3	20.50	221,462,984	222,683,461	227,005,923	234,136,529
Montana	2	26.21	283,078,473	284,808,553	314,858,291	312,068,011
Nevada	5	5.97	64,494,640	64,359,398	53,849,281	57,976,477
New Hampshire	19	.....	12,409	12,409	88,944	.....
New Mexico	11	.35	3,784,609	4,614,386	5,031,136	5,393,146
North Carolina	15	.02	181,263	140,514	120,451	224,514
Oregon	18	.....	22,022	13,861	245,408	235,000
Pennsylvania	12	.07	740,026	927,360	994,089	[a] 608,745
Philippine Islands	22	.....	1,781	.....	.....	.....
South Dakota	24	.....	43	.....	41,968	[b] 122,270
Tennessee	7	1.54	16,691,777	16,837,727	19,207,747	19,206,806
Texas	20	.....	2,961	3,157	3,456	.....
Utah	4	11.59	125,185,455	127,597,072	101,241,114	108,947,811
Vermont	21	.....	1,935	.....	.....	.....
Virginia	16	.01	105,313	5,402	231,971	224,162
Washington	17	.01	65,021	36,918	120,611	255,134
Wyoming	14	.02	217,127	222,339	433,672	492,539
Missouri and unapportioned	13	.06	603,570	94,452	2,159,636	1,200,000
Total	.....	.....	1,080,159,509	1,088,237,432	1,092,951,624	1,126,521,126

[a] Includes New Hampshire and Maryland. [b] Includes Alabama, South Carolina, and Texas.

In the distribution of the blister output to the States of origin it is necessary to have reports not only from blister producers but also from matte smelters, as the matte is credited by the smelter that converts it to the State from which it was received, although the matte smelter may have received its ores from several States. In the adjustment of the products of these matte smelters slight errors in the distribution of the blister production are probably introduced.

The following table shows the production from 1845 to 1910 for each State for which separate statistics are available. The statistics from 1882 to 1910 are compiled from reports made by the producing companies to the United States Geological Survey. Prior to 1882, the statistics for individual States have been compiled from the best sources available, and although they are not comparable with the later statistics in accuracy, they are believed to represent approximately the output of the individual States. The totals for the United States prior to 1882 are taken from compilations made in previous volumes of Mineral Resources.

Production of copper in the United States, 1845–1910, by States, in pounds.

State.	1845	1846	1847	1848	1849	1850
Michigan	26,880	58,240	477,120	1,032,640	1,505,280	1,281,280
Eastern States and unapportioned	197,120	277,760	194,880	87,360	62,720	174,720
Total	224,000	336,000	672,000	1,120,000	1,568,000	1,456,000

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Production of copper in the United States, 1845–1910, by States, in pounds—Continued.

State.	1851	1852	1853	1854	1855
Michigan	1,744,960	1,774,080	2,905,280	4,074,560	5,808,320
Eastern States and unapportioned	271,040	689,920	1,574,720	965,440	911,680
Total	2,016,000	2,464,000	4,480,000	5,040,000	6,720,000

State.	1856	1857	1858	1859	1860
Michigan	8,211,840	9,531,200	9,157,120	8,926,400	12,069,120
Eastern States and unapportioned	748,160	1,220,800	3,162,880	5,185,600	4,058,880
Total	8,960,000	10,752,000	12,320,000	14,112,000	16,128,000

State.	1861	1862	1863	1864	1865
Arizona		80,000			
California		2,600,000	2,200,000	4,800,000	3,600,000
Michigan	15,037,120	13,585,600	12,985,280	12,490,240	14,358,400
New Mexico	[a] 1,000,000				
Eastern States and unapportioned	762,880	4,894,400	3,854,720	629,760	1,081,600
Total	16,800,000	21,160,000	19,040,000	17,920,000	19,040,000

State.	1866	1867	1868	1869	1870
Arizona		984,000			
California	2,600,000	1,400,000	1,300,000	575,000	55,000
Colorado	112,000				
Idaho				9,000	
Michigan	13,749,120	17,525,760	20,935,040	26,624,640	24,622,080
Montana			4,000	8,000	
New Mexico					12,600
Eastern States and unapportioned	3,474,880	2,490,240	3,744,960	783,360	3,534,320
Total	19,936,000	22,400,000	25,984,000	28,000,000	28,224,000

State.	1871	1872	1873	1874	1875
Arizona		840,000		450,000	500,000
California	600,000	350,000	450,000	320,000	
Colorado				500,000	400,000
Idaho					
Michigan	26,748,080	24,552,640	30,089,920	34,332,480	36,039,360
Montana			100,000		100,000
New Mexico			32,000	50,000	300,000
Nevada			144,000	370,000	
Utah		450,000	875,000	150,000	130,000
Eastern States and unapportioned	1,771,920	1,807,360	3,029,080	3,027,520	2,850,640
Total	29,120,000	28,000,000	34,720,000	39,200,000	40,320,000

State.	1876	1877	1878	1879	1880
Arizona	500,000	3,000,000	3,000,000	3,183,750	2,000,000
California		500,000	400,000	512,000	1,000,000
Colorado	500,000	600,000		1,578	
Michigan	38,370,300	39,025,280	39,690,560	42,848,960	49,736,960
Montana	520,000	400,000	350,000	500,000	1,212,000
New Mexico	308,000			4,055	
Nevada				134,730	
Utah	157,000				
Eastern States and unapportioned	2,204,700	3,514,720	4,719,440	4,334,927	6,531,040
Total	42,560,000	47,040,000	48,160,000	51,520,000	60,480,000

[a] Comprises period 1858–1861, inclusive.

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Production of copper in the United States, 1845–1910, by States, in pounds—Continued.

State.	1881	1882	1883	1884	1885
Arizona	8,000,000	17,984,415	23,874,963	26,734,345	22,706,366
California	500,000	826,695	1,600,862	876,166	469,028
Colorado[a]	1,750,000	1,494,000	1,152,652	2,013,125	1,146,460
Idaho				46,667	40,381
Michigan	53,573,120	56,982,765	59,702,404	69,353,202	72,148,172
Montana	1,450,000	9,058,284	24,664,346	43,093,054	67,797,864
New Mexico	500,000	869,498	823,511	59,450	79,839
Nevada		350,000	288,077	100,000	8,871
Utah		605,880	341,885	265,526	126,199
Washington					
Wyoming		100,000	962,468		
Eastern States and unapportioned	5,906,880				
Eastern States		1,555,000	612,124	904,423	211,602
Southern States		400,000	395,175	317,711	40,199
Middle States		294,695	324,706	232,114	190,641
Lead desilverizers and unapportioned		125,000	782,880	950,870	910,144
Total	71,680,000	90,646,232	115,526,053	144,946,653	165,875,766

State.	1886	1887	1888	1889	1890
Arizona	15,657,035	17,720,462	31,797,300	31,586,185	34,796,689
California	430,210	1,600,000	1,570,021	151,505	23,347
Colorado[a]	409,306	2,012,027	1,621,100	1,170,053	3,585,691
Idaho			50,000	156,490	87,243
Michigan	79,890,798	75,471,890	86,472,034	88,175,675	101,410,277
Montana	57,611,621	78,699,677	97,897,968	98,222,444	112,980,896
New Mexico	558,385	283,664	1,631,271	3,686,137	850,034
Nevada	50,000		50,000	26,420	
Utah	500,000	2,500,000	2,131,047	65,467	1,006,636
Washington					
Wyoming			232,819	100,000	
Eastern States	315,719	200,000	271,631	72,000	
Southern States	29,811		18,201	18,144	378,840
Middle States					
Lead desilverizers and unapportioned	1,282,496	2,432,804	2,618,074	3,345,442	4,643,439
Total	156,735,381	180,920,524	226,361,466	226,775,962	259,763,092

State.	1891	1892	1893	1894	1895
Arizona	39,873,279	38,436,099	43,902,824	44,514,894	47,953,553
California	3,397,405	2,980,944	239,682	120,000	218,332
Colorado[a]	6,336,878	7,593,674	7,695,826	6,481,413	6,079,243
Idaho	146,825	226,000	36,367		1,425,914
Michigan	114,222,709	123,198,460	112,605,078	114,308,870	129,330,749
Montana	112,063,320	163,206,128	155,209,133	183,072,756	190,172,150
New Mexico	1,233,197	1,188,796	280,742	31,884	143,719
Nevada			20,000		
Utah	1,562,098	2,209,428	1,135,330	1,147,570	2,184,708
Washington			39,785		
Wyoming					
Eastern States					
Southern States	296,463	467,448	732,793	2,374,514	3,105,036
Middle States					
Lead desilverizers and unapportioned	4,989,590	5,491,702	7,456,838	2,136,473	
Total	284,121,764	344,998,679	329,354,398	354,188,374	380,613,404

[a] For several of the early years the production credited to Colorado includes the yield from some ores of uncertain origin which were smelted in Colorado plants.

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Production of copper in the United States, 1845–1910, by States, in pounds—Continued.

State.	1896	1897	1898	1899	1900
Arizona	72,934,927	81,530,735	111,158,246	133,054,860	118,317,764
California	690,237	11,987,772	16,925,634	26,221,897	28,511,225
Colorado[a]	6,022,176	11,873,033	16,274,561	11,643,608	7,826,949
Idaho		183,277	1,266,920	110,000	290,162
Michigan	143,524,069	145,282,059	158,491,703	147,400,338	145,461,498
Montana	221,918,179	230,288,141	206,173,157	225,126,855	270,738,489
New Mexico	2,701,664	701,892	1,592,371	3,935,441	4,169,400
Nevada			437,396	556,775	407,535
South Dakota		2,440,338	1,261,393	17,020	15,147
Utah	3,502,012	3,919,010	3,750,000	9,584,746	18,354,726
Wyoming			233,044	3,104,827	4,203,776
Eastern States, Southern States, Middle States	4,704,993	4,472,017	5,395,226	4,410,554	4,820,495
Lead desilverizers and unapportioned	4,063,173	[b] 1,400,000	3,553,336	[b] 3,500,000	[b] 3,000,000
Total	460,061,430	494,078,274	526,512,987	568,666,921	606,117,166

State.	1901	1902	1903	1904	1905
Alaska			1,339,590	2,043,586	4,900,866
Arizona	130,778,611	119,944,944	147,648,271	191,602,958	235,906,150
California	33,667,456	25,038,724	17,776,756	28,529,023	16,697,489
Colorado	9,801,783	8,422,030	4,158,368	9,506,944	9,404,830
Idaho	480,511	227,500	778,906	2,158,858	7,321,585
Michigan	156,289,481	170,609,228	192,400,577	208,309,130	230,287,992
Montana	229,870,415	288,903,820	272,555,854	298,314,804	314,750,582
New Mexico	9,629,884	6,614,961	7,300,832	5,368,066	5,334,192
Nevada	593,608	164,301	[a] 150,000		413,202
Oregon					846,615
South Dakota	753,510	445,663	173,202	[a] 100,000	38
Utah	20,116,979	23,939,901	38,302,602	47,062,889	58,153,393
Washington		209,297	80,758	663,694	223,328
Wyoming	2,698,712	889,228	1,023,189	3,565,629	2,530,531
Eastern States, Southern States, Middle States	6,860,039	13,599,047	13,855,612	15,211,086	15,134,960
Lead desilverizers and unapportioned	531,530	[b] 500,000	[b] 500,000	[b] 100,000	
Total	602,072,519	659,508,644	698,044,517	812,537,267	901,907,843

State.	1906	1907	1908	1909	1910
Alaska	8,685,646	7,034,763	4,438,836	4,057,142	4,311,026
Arizona	262,566,103	256,778,437	289,523,267	291,110,208	297,250,538
California	28,153,202	33,696,402	39,643,835	53,568,708	45,760,200
Colorado	7,427,253	13,998,496	13,943,878	11,485,631	9,307,497
Idaho	8,578,046	9,707,299	7,256,086	7,096,132	6,877,515
Michigan	229,695,730	219,131,503	222,289,584	227,005,923	221,462,984
Montana	294,701,252	224,263,789	252,503,651	314,858,291	283,078,473
New Mexico	7,099,842	10,140,140	4,991,351	5,031,136	3,784,609
Nevada	1,090,635	1,998,164	12,241,372	53,849,281	64,494,640
Oregon	545,859	518,094	271,191	245,403	22,022
South Dakota			5,471	41,988	43
Utah	50,329,119	66,418,370	71,370,370	101,241,114	125,185,455
Washington	290,823	122,263	162,201	120,611	65,021
Wyoming	106,177	3,026,004	2,416,197	433,672	217,127
Eastern States and unapportioned	18,535,995	22,161,967	21,513,431	22,806,294	18,342,359
Total	917,805,682	868,996,491	942,570,721	1,092,951,624	1,080,159,509

[a] For several of the early years the production credited to Colorado includes the yield from some ores of uncertain origin which were smelted in Colorado plants.
[b] Based partly on estimates.

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Total production by States, 1845–1910, and percentage and rank of each State.

State.	Quantity.	Percentage.	Rank.
	Pounds.		
Alaska	30,811,455	0.24	11
Arizona	3,200,184,268	20.93	3
California	445,134,957	2.91	5
Colorado	203,752,063	1.33	7
Idaho	54,557,084	.36	10
Michigan	4,756,420,142	31.10	2
Montana	5,326,439,393	34.83	1
New Mexico	92,323,163	.60	9
Nevada	137,939,097	.90	8
Oregon	2,449,784	.02	14
South Dakota	5,253,513	.04	13
Utah	658,774,460	4.31	4
Washington	1,977,781	.01	15
Wyoming	25,843,400	.17	12
Eastern States and unapportioned	344,629,883	2.25	6
Total	15,292,491,343	100.00	.....

The totals in the preceding table show the copper output of each important copper-producing State, except those on the Atlantic coast, since the beginning of the industry. Some copper was produced from New Mexico in the early years of the last century, but the exact quantity is not known. It was not large as measured by present production of the metal. A little copper was also produced in Michigan prior to 1845, but it was not sufficient in quantity to be of importance. Considerable copper was produced in the Eastern States prior to 1845.

Under "Eastern States and unapportioned" is included some copper classed as "lead desilverizers, etc." in the earlier reports of the Survey. This should properly be credited to some of the Western States. The output of the Central States, except Michigan, is also included under this head. Statistics for the individual Eastern States have not been compiled, but it may be stated that approximately 211,700,000 pounds has been derived from Tennessee. Of the remainder, Vermont and Virginia have made the largest contributions, and some copper has been produced by practically all of the Appalachian States.

It will be noted that Montana, Michigan, and Arizona stand out as the three great copper-producing States. Montana ranks first, with more than one-third of the entire output of the country; Michigan ranks second, with slightly less than one-third; and Arizona ranks third, with over one-fifth of the total output. Utah, ranking next in order, has produced less than one-twentieth of the total output. The three leading States have produced 86.86 per cent of the entire production.

It will be noted by reference to the table showing the output for 1910 that the three States still maintain their preeminence, producing 81 per cent of the total output in 1908, 76 per cent in 1909, and 74 per cent in 1910. The relative importance of other States, however, is much greater in recent years, Utah producing 11.6 per cent of the total 1910 output. The six leading States in 1910, Arizona, Montana, Michigan, Utah, Nevada, and California, produced 96 per cent of the output for that year. The same States have produced 95 per cent of the total output since 1845.

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In the following table is given the blister copper output of the leading districts of the country in 1910:

Blister copper production of principal districts in 1910, in pounds.

District or region.	State.	Approximate smelter output.	Percentage of total production.	Rank.
Butte	Montana	282,500,000	26.16	1
Lake Superior	Michigan	221,400,000	20.5	2
Bisbee	Arizona	142,500,000	13.19	3
Bingham	Utah	112,000,000	10.37	4
Morenci-Metcalf	Arizona	73,100,000	6.76	5
Ely	Nevada	63,200,000	5.85	6
Jerome	Arizona	38,600,000	3.57	7
Shasta County	California	36,000,000	3.33	8
Globe	Arizona	27,600,000	2.56	9
Ducktown	Tennessee	16,700,000	1.55	10
Tintic	Utah	9,000,000	.82	11
Calaveras County	California	8,000,000	.74	12
Silverbell	Arizona	5,700,000	.53	13
Coeur d'Alene	Idaho	5,000,000	.46	14
Courtland	Arizona	4,700,000	.43	15
Leadville	Colorado	3,600,000	.33	16
San Juan-Ouray region	do	2,800,000	.26	17
Santa Rita	New Mexico	2,670,000	.24	18
Prince William Sound	Alaska	2,300,000	.21	19
Southeastern Alaska	do	2,000,000	.19	20
Big Bug	Arizona	2,000,000	.19	21
Total		1,061,370,000	98.24	
All others		18,630,000	1.76	
Grand total		1,080,000,000	100.00	

As shown in this table 21 districts in 1910, as compared with 19 districts in 1909, each produced 2,000,000 or more pounds of blister copper. The 21 districts in 1910 produced more than 98 per cent of the copper output of the country; the 19 districts in 1909 produced 97.5 per cent of the total. In 1910 the 10 leading districts, only one of which yielded less than 20,000,000 pounds, produced nearly 94 per cent of the total output, as compared with 93 per cent in 1909 for the same districts.

The following table shows the output of the principal copper-producing districts of the United States from the beginning of production to the close of 1910. For the later years the statistics are compiled from reports furnished to the United States Geological Survey by the producing companies. For the earlier years the figures are taken mainly from reports on the several districts by members of the Geological Survey.

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Total blister copper production of principal districts to the close of 1910, in pounds, and percentage of total and rank of each.

District.	State.	Production began.	Pounds.	Percentage of total production.	Rank.
Butte	Montana	1868	[a] 5,315,000,000	34.75	1
Lake Superior	Michigan	1845	[b] 4,756,000,000	31.10	2
Bisbee	Arizona	1880	[c] 1,285,000,000	8.40	3
Morenci-Metcalf	Arizona	1873	[d] 882,700,000	5.77	4
Jerome	Arizona	1883	[e] 570,000,000	3.72	5
Bingham	Utah	1896	[f] 465,000,000	3.04	6
Shasta County	California	1897	[g] 336,000,000	2.19	7
Globe	Arizona	1881	[h] 334,700,000	2.18	8
Ducktown	Tennessee	1850	[i] 211,700,000	1.38	9
Ely	Nevada	1908	[j] 125,000,000	.81	10
Foothill belt	California	1862	[k] 104,000,000	.68	11
Santa Rita	New Mexico	1800(?)	[l] 103,000,000	.67	12
All others			804,300,000	5.31	
Total			15,292,400,000	100.00	

[a] The output of Montana, from which the estimated production of other districts of the State has been deducted.
[b] The Michigan output is taken from Mineral Resources of the United States.
[c] Production of earlier years has been taken from Prof. Paper U. S. Geol. Survey No. 21, 1904.
[d] Production of earlier years has been taken from Prof. Paper U. S. Geol. Survey No. 43, 1905.
[e] Figures from 1898 to 1910 furnished by the United Verde Copper Co. Output prior to 1898 compiled from Mineral Industry and mining journals.
[f] Production of earlier years has been taken from Prof. Paper U. S. Geol. Survey No. 38, 1906.
[g] Production of earlier years has been taken from Bull. U. S. Geol. Survey No. 430, 1910, p. 75.
[h] Production of earlier years has been taken from Prof. Paper U. S. Geol. Survey No. 12, 1902.
[i] Figures compiled by Prof. W. H. Emmons.
[j] From reports of operating companies to the United States Geological Survey.
[k] Estimated from total output of California.
[l] Early production taken from Prof. Paper U. S. Geol. Survey No. 68, 1910.

Twelve districts situated in eight States have each contributed in excess of 100,000,000 pounds to the copper output of the country. Four of these districts are in Arizona, 2 in California, and 1 each in Montana, Michigan, Nevada, New Mexico, Tennessee, and Utah. Two districts stand out prominently. They are the Butte district, Montana, which has contributed slightly over one-third of the output of the country, and the Lake Superior district, Michigan, with a production of a little less than one-third of the total output. Bisbee, ranking third, has yielded 8.4 per cent of the total production. The 12 districts have yielded 94.69 per cent of the total output of the United States since 1845.

It will be seen by a comparison of the table showing the total output of the leading districts with the table showing the output of the leading districts in 1910 that the first 10 are the same, but that the order is changed to some extent. These districts have yielded 93.34 per cent of the total output and 93.84 per cent of the production of 1910.

It is noteworthy that nearly every one of the leading producing districts has made a record output within the last three years and nearly every one of them could have done so in 1910, so far as the ability of the mines to produce the ore was concerned. An indifferent copper market and metallurgical difficulties, however, resulted in a decrease in the output in 1910 for several of the districts.

It is also noteworthy that there is not a single instance where one of the leading copper districts of the United States, several of which have been active producers for a period of 30 years or more, has been worked out or showed a decrease in its ability to produce copper.

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TONNAGE AND YIELD OF COPPER ORES.

COPPER-BEARING ORES PRODUCED IN 1910.

The following tables show the tonnage and the yield in copper of the ores produced by the mines of the United States in 1910. The figures are taken from the mine reports of the various States, which form a part of the volume on Mineral Resources issued annually by the United States Geological Survey. As stated in a preceding paragraph, the close agreement between the output as reported by the mines and the actual recovery of metal by the smelters, when accumulated stocks are considered, leads to the belief that the tenor of ores as reported by the mines is very close to the actual recovery of metal. The classification of some of the complex western ores is a difficult and more or less arbitrary matter. Under copper ores are classed those which contain 2½ per cent or more of copper, as well as those which contain less than this percentage, provided their principal value is in copper. Under copper-lead and copper-zinc ores are classed complex ores in which copper is an important constituent. Considerable copper was reported by the mines from ores mined primarily for other metals, including siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for values in other metals. No attempt has been made to compile tables showing the tonnage and yield of this group of copper-bearing ores, but together with old slags, etc., they yielded a total of 13,846,998 pounds, or about 1 per cent of the total output.

Copper produced in 1910 from ores in which copper constitutes the principal value, by States.

State.	Copper ore.	Copper in ore.	Percentage.	Gold in ore.	Silver in ore.	Value in gold and silver per ton.
	Short tons.	*Pounds.*		*Fine ounces.*	*Fine ounces.*	
Alaska	39,365	4,241,089	5.38	1,764.91	26,388	$1.29
Arizona	3,644,495	296,739,350	4.07	52,707.40	1,934,363	.59
California	716,685	48,672,937	3.39	31,844.68	1,363,668	1.94
Colorado	15,078	1,489,064	4.94	8,961.27	436,358	27.85
Idaho	70,163	5,912,392	4.21	765.80	475,363	3.88
Michigan	10,869,561	222,683,461	1.02	.....	330,500	.01
Montana	4,517,709	283,072,965	3.13	31,441.93	9,153,590	1.24
Nevada	2,375,490	64,151,251	1.35	21,230.87	107,365	.21
New Hampshire	569	12,409	1.09	18.24	476	1.11
New Mexico	55,220	3,961,406	3.58	1,449.41	60,228	1.13
North Carolina	2,221	140,514	3.16	60.66	8,454	2.62
Oregon	68	13,861	10.19	1.98	535	4.85
Pennsylvania	218,183	927,360	.21	272.83	50	.02
Tennessee	552,796	16,837,727	1.52	126.40	81,237	.08
Texas	17	1,740	5.11	1.20	30	2.41
Utah	5,417,558	124,306,847	1.15	113,978.50	2,036,909	.64
Virginia	271	5,462	.99	6.48	128	.75
Washington	819	43,597	2.66	5.39	7,475	5.06
Wyoming	970	222,174	11.45	42.13	1,307	1.62
Total and average	28,497,238	1,073,436,846	1.88	264,680.08	16,024,424	.49

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Copper ores concentrated and smelted, concentrates produced, and copper produced from each class of ore in 1910, by States.

State.	Ore concentrated.				Ore smelted.		
	Quantity.	Concentrates produced.	Copper in concentrates.	Percentage of copper from ore.	Quantity.	Copper produced.	Percentage of copper from ore.
	Short tons.	*Short tons.*	*Pounds.*		*Short tons.*	*Pounds.*	
Alaska					39,365	4,241,689	5.38
Arizona	1,417,602	251,750	59,388,594	2.09	2,226,803	237,350,756	5.33
California	3,031	303	25,882	.426	713,654	48,647,055	3.41
Colorado					15,078	1,489,564	4.94
Idaho	52	13	1,114	1.07	70,111	5,911,278	4.21
Michigan	10,869,561	180,420	222,683,461	1.02			
Montana	3,978,893	1,236,994	221,825,506	2.79	538,816	61,247,459	5.68
Nevada	2,346,354	211,241	62,332,419	1.30	29,136	1,818,832	3.12
New Hampshire					569	12,409	1.09
New Mexico	33,922	1,902	937,454	1.38	21,298	3,023,952	7.09
North Carolina					2,221	140,514	3.163
Oregon					68	13,861	10.19
Pennsylvania					218,183	927,360	.2126
Tennessee					552,796	16,837,727	1.523
Texas					17	1,740	5.11
Utah	4,846,429	181,201	91,975,100	.95	571,129	32,331,747	2.83
Virginia					271	5,402	.9965
Washington					819	43,697	2.66
Wyoming					970	222,174	11.45
Total and average	23,495,844	2,063,824	659,169,530	1.40	5,001,394	414,267,316	4.14

Copper produced from copper-lead and copper-zinc ores in 1910, by States.

State.	Copper-lead and copper-zinc ores.	Copper in ore.	Percentage of copper.
	Short tons.	*Pounds.*	
Arizona	1,193	67,704	2.96
Colorado	2,219	148,049	3.33
Montana	1,524	128,127	4.20
Nevada	385	29,955	3.89
New Mexico	15	1,505	5.00
Utah	14,982	578,250	1.93
Total and average	20,318	953,590	2.34

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Copper derived from ore classed as copper-bearing ores (copper, copper-lead, and copper-zinc ores), and total production of copper from all sources in 1910, by States.

State.	Ore treated.	Copper recovered.	Percentage of copper.	Copper from all sources, including old slags, smelter cleanings, precipitates, etc.
	Short tons.	*Pounds.*		*Pounds.*
Alaska	39,365	4,241,689	5.88	4,241,689
Arizona	8,645,688	296,807,054	4.07	[a] 297,491,151
California	716,685	48,672,937	3.39	48,700,756
Colorado	17,297	1,637,713	4.73	[b] 8,359,535
Idaho	70,163	5,912,392	4.21	[c] 7,037,292
Michigan	10,869,561	222,683,461	1.02	222,683,461
Missouri				[d] 94,452
Montana	4,519,233	283,201,092	3.13	[e] 284,808,553
Nevada	2,375,875	64,181,206	1.35	[a] 64,359,398
New Hampshire	569	12,409	1.09	12,409
New Mexico	55,235	3,962,911	3.58	[f] 4,614,386
North Carolina	2,221	140,514	3.16	140,514
Oregon	68	13,861	10.19	13,861
Pennsylvania	218,183	927,360	.212	927,360
Tennessee	552,796	16,837,727	1.52	16,837,727
Texas	17	1,740	5.11	3,157
Utah	5,432,540	124,885,097	1.15	[g] 127,597,072
Virginia	271	5,402	.996	5,402
Washington	819	43,697	2.66	[f] 86,918
Wyoming	970	222,174	11.45	222,334
Total and average	28,517,556	1,074,390,436	1.88	1,088,237,432

[a] Some copper was produced from siliceous and lead ores.
[b] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.
[c] Considerable copper is produced from ores classed as lead ores.
[d] By-product of lead ores.
[e] Considerable copper was produced from zinc and siliceous ores.
[f] Considerable copper was produced from siliceous ores.
[g] Considerable copper was recovered from ores classed as siliceous ores and lead ores.

Copper ores produced in the United States, 1906–1910, by years, in short tons, and average yield in copper, gold, and silver.

Year.	Copper ore.	Yield in copper.	Yield per ton in gold.	Yield per ton in silver.	Value per ton in gold and silver.
	Short tons.	*Per cent.*	*Ounces.*	*Ounces.*	
1906	18,000,000	2.50	0.0150	0.882	$0.856
1907	20,253,000	2.11	.0135	.609	.682
1908	22,290,886	2.07	.0104	.666	.560
1909	27,932,618	1.98	.0097	.655	.540
1910	28,497,238	1.88	.0093	.562	.495

Copper ores produced in the United States, 1906–1910, by years, classified as smelting and concentrating ores, in short tons, and average yield in copper from each.

Year.	Smelting ore.		Concentrating ore.	
	Quantity.	Yield in copper.	Quantity.	Yield in copper.
	Short tons.	*Per cent.*	*Short tons.*	*Per cent.*
1906	3,278,000	.....	14,722,000	.....
1907	3,957,500	4.05	16,295,500	1.41
1908	4,665,534	4.27	17,760,522	1.485
1909	5,267,707	4.15	22,664,911	1.47
1910	5,001,394	4.14	23,495,844	1.40

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TONNAGE.

The output of copper, copper-lead, and copper-zinc ores mined in 1910 was 28,517,556 tons, as compared with 28,025,092 tons in 1909. Of this output 28,497,238 tons were copper ores and 20,318 tons were copper-lead and copper-zinc ores, as compared with 27,932,618 tons of copper ores and 92,474 tons of copper-lead and copper-zinc ores in 1909. Of the 28,497,238 tons of copper ores, 5,001,394 tons were smelting ores and 23,495,884 tons were concentrating ores, as compared with 5,267,707 tons of smelting ores and 22,664,911 tons of concentrating ores in 1909. In 1910 concentrating ores produced 2,063,824 tons of concentrates, the average concentration being 11.3 into 1, as compared with 9.7 into 1 in 1909 and with 10.8 into 1 in 1908. Excluding the ores and concentrates from Michigan, 12,626,-283 tons of ore produced 2,150,429 tons of concentrates, or a concentration of about 6.7 into 1, as compared with 5.6 into 1 for 1909.

It is seen by reference to the tables showing the production of ores for the last five years that there has been an increase of over 50 per cent in the tonnage mined since 1906. The actual increase, of course, is most in concentrating ores, though the relative increase in this type is not very much greater than in the crude smelting ores. The output of smelting ores has increased about 52 per cent, and that of concentrating ores has increased about 60 per cent. Michigan, with 10,869,561 tons, was by far the largest producer of copper ores in 1910, and was followed in order by Utah, Montana, Arizona, Nevada, California, and Tennessee. In the output of smelting ores the States were in the following order: Arizona, California, Utah, Tennessee, and Montana; in the output of concentrating ores Michigan was first, followed in order by Utah, Montana, Nevada, and Arizona.

YIELD.

The 28,517,556 tons of copper, copper-lead, and copper-zinc ores mined in 1910 contained 1,074,390,436 pounds of recoverable copper, or an average of 1.88 per cent, as compared with 1.98 per cent for 1909 and with 2.08 per cent for 1908. If the Michigan output is excluded, the yield of the remaining copper ores was 2.41 per cent in 1910, as compared with 2.63 per cent in 1909 and with 2.98 per cent in 1908.

In 1910 copper ores produced 1,073,436,846 pounds of copper, or an average yield of 1.88 per cent copper, and copper-lead and copper-zinc ores produced 953,590 pounds, or an average yield of 2.34 per cent copper. The 5,001,394 tons of smelting ore yielded 414,267,316 pounds of copper, or an average of 4.14 per cent, as compared with 4.15 per cent for 1909 and with 4.27 per cent for 1908. The 23,495,844 tons of concentrating ore yielded 659,169,530 pounds, or an average of 1.40 per cent, as compared with 1.47 per cent for 1909 and with 1.48 per cent for 1908. Excluding the ores from Michigan, which yielded an average of 1.02 per cent in 1910, the same as in 1909, the concentrating ores from the remainder of the United States yielded an average of 1.73 per cent, as compared with 1.92 per cent in 1909 and with 2.10 per cent in 1908.

As shown in the table giving yield in copper, gold, and silver, there has been a marked decrease in the tenor of copper ores treated during the last five years, the average yield dropping from 2.50 per cent in

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1906 to 1.88 per cent in 1910. The average yield of the smelting and the concentrating ores, considered separately, shows much less change, the decrease in the average of total ores being due largely to an increase in the tonnage of concentrating ores.

Among the important copper-producing States Arizona retained the lead in the yield of copper per ton of ore, the average yield for 1910 being 4.07 per cent; California was second, with a yield of 3.39 per cent; Montana was third, with 3.13 per cent; and Tennessee, Nevada, Utah, and Michigan followed in the order given.

Of the States producing an important tonnage of crude smelting ores, Montana had the highest yield, with an average of 5.68 per cent; Arizona was second, with a yield of 5.33 per cent; and California, Utah, and Tennessee followed, with yields of 3.41, 2.83, and 1.52 per cent, respectively.

In the yield from concentrating ores Montana took first rank with an average of 2.79 per cent, followed by Arizona, with 2.09 per cent; Nevada, 1.30 per cent; Michigan, 1.02 per cent; and Utah, 0.95 per cent.

In 1910 copper ores yielded 264,680.08 ounces of gold and 16,024,424 ounces of silver, or an average of 0.0093 ounce of gold and 0.562 ounce silver per ton. The total value of the gold and silver content of copper ores was $14,124,509, an average precious-metal value of 49.5 cents per ton. In 1909 copper ores yielded 0.00975 ounce gold and 0.655 ounce silver per ton, an average precious-metal value of 54 cents per ton. Exclusive of that portion of the Michigan ores from which the silver was not recovered, the average precious-metal content was 73.8 cents per ton of ore, as compared with 83.4 cents in 1909 and with 91 cents in 1908.

Exclusive of the Michigan ores that did not yield silver, there was still included considerable ore from which the gold and silver values were not recovered, namely, that producing the casting copper from the Morenci-Metcalf district, Arizona, and from the Ducktown district, Tennessee, and to a slight extent from other districts. This casting copper was not electrolytically refined, and consequently the precious-metal values were not recovered from it.

Among the important copper-producing States California was first in the value of gold and silver per ton of copper ore, the average being $1.94; Montana followed with an average of $1.24; Utah with $0.64; Arizona, $0.59; Nevada, $0.21; Tennessee, $0.08; and Michigan, $0.01.

REVIEW BY STATES.

INTRODUCTORY STATEMENT.

In the following pages a brief statement of the conditions affecting production in the principal districts of the country is presented, the geologic occurrence of the ores is briefly summarized, and the tenor of ore from each district is given when this will not disclose the production of individual companies, the figures of whose output have not already been published in their annual report or elsewhere.

Those desiring more detailed information of the mining operations of the districts are referred to the reports on mine production for the various States, which have been published by the United States Geological Survey and which, with this and other reports, form the

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first part of the volume Mineral Resources of the United States for 1910.

The accompanying map (Plate I, in pocket) shows the location of the districts that have contributed to any important extent to the output of copper during the last three years. Unfortunately, such a limitation in time excludes some districts which contain valuable copper deposits but which were not producers during the period covered, and on the other hand it includes districts that will probably never be of importance and yet which have produced during the specified period.

The period of the last three years has been taken in order to exclude many small districts and plants that were operated during the "boom times" of 1906 and 1907, but which will never be of permanent importance as copper producers. The symbol showing the relative output of the principal camps from the beginning of production must also be correctly read and not be interpreted as representing the present relative importance of the various districts or in any way to represent the possibilities of those districts. Several districts that show very poorly on total relative output were important contributors in 1910, and still others whose relative output is not represented will be important producers in a short time.

In the case of a few districts making an important output in the early days it has not been possible to get even a close approximation of their total production, and consequently their relative importance could not be shown.

The actual figures upon which the relative output is based will be found in the table showing the production of the principal districts and in the description of the individual districts. The present relative importance of the several districts can be ascertained by consulting the table showing the output of the principal districts for 1910.

The list of reduction plants accompanying the map includes all copper smelters and refineries operated during the last three years, though several of these are no longer in operation, and it also includes copper smelting plants in process of construction during 1910.

ALASKA.

The blister copper production from Alaska in 1910 was 4,311,026 pounds, as compared with 4,057,142 pounds in 1909.

Important production began in Alaska in 1903 and it reached its maximum production of 8,685,646 pounds in 1906. Since the fall in the price of copper in 1907, the Alaska production has been much less. The total output to the close of 1910 has been 36,811,455 pounds. With the entrance of the Copper River district into the producing list and increased activity in the Prince William Sound district, the output for 1911 should show a material increase. The output for 1910 as in previous years was from the Ketchikan and the Prince William Sound districts.

Ketchikan district.—The Ketchikan district yielded about 2,000,000 pounds of blister copper in 1910, as compared with about 2,700,000 pounds in 1909. The deposits of the district[1] thus far developed are

[1] For detailed descriptions see Wright, C. W., and Paige, S., Mineral resources of Alaska in 1907: Bull. U. S. Geol. Survey No. 345, 1908, pp. 98–115; and Wright, F. E., and Wright, C. W., Ketchikan and Wrangell mining districts, Alaska: Bull. U. S. Geol. Survey No. 347, 1908.

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of contact origin, the ores run high in iron, being composed of pyrrhotite, magnetite, pyrite, and chalcopyrite and are a desirable ore for the British Columbia and Washington smelters. Neither of the smelting plants in the district was in operation during 1910, the ores being shipped to the Ladysmith and the Tacoma smelters. Only the relatively high-grade ores are shipped, as the low-grade materal can not be marketed profitably at the present price of copper. The average yield in copper is between 4 and 5 per cent, and the ores carry rather low values in gold and silver.

Prince William Sound district.—The Prince William Sound district produced about 2,300,000 pounds of blister copper in 1910, a distinct increase over the production of 1909. The principal output was from Latouche Island, the Beatson Bonanza mine being the largest producer. During the year the property passed into the hands of the Guggenheim-Morgan interests and plans for an increased output were inaugurated. The ores of the district were shipped to the Tacoma smelter, only the relatively high-grade ore being shipped. The deposits [1] consist of pyrrhotite, chalcopyrite, and pyrite, with minor amounts of other sulphides occurring in sheer zones in or closely associated with greenstone.

Copper River district.—No production was made from the Copper River district during 1910, but work was continued on the Copper River and Northeastern Railroad which reached the Bonanza mine in the spring of 1911, when ore shipments began, the first train load of ore leaving the mine on April 6.

To the close of 1910 the Bonanza mine was the only deposit developed in the district that promises to make important production in the near future. This mine, the property of the Kennicott Mines Co., controlled by the Guggenheim-Morgan interests, is situated near the head of Bonanza Creek near Kennicott Glacier.

The primary ores [2] are principally chalcocite with some bornite, replacing limestone near a greenstone contact. These minerals have been partly altered to carbonates at the surface. This is one of the few copper deposits known in which chalcocite, the principal ore mineral, is regarded as a primary mineral. Much of the ore is almost pure chalcocite and is very high grade. The district should make a considerable production of copper during 1911.

ARIZONA.

In 1910 Arizona produced 297,250,538 pounds of blister copper, as compared with 291,110,298 pounds in 1909. This is the largest output in the history of the Territory and again gives Arizona first rank among the copper-producing States, a place lost to Montana in 1909. With the added output of new producers in 1911, Arizona will doubtless maintain her supremacy as a copper producer for many years.

The steady output of copper from Arizona began about 1875, though there was intermittent production prior to that date, the earliest record of production being for 1862. Since 1880 the growth of the industry has been steady and rapid. To the close of 1910, Arizona had a recorded production of 3,200,184,268 pounds

[1] Grant, U. S., and Higgins, D. F., Reconnaissance of the geology and mineral resources of Prince William Sound, Alaska: Bull. U. S. Geol. Survey No. 443, 1910, pp. 87–96.

[2] Moffit, F. H., and Maddren, A. G., Mineral resources of Kotsina-Chittina region, Alaska: Bull. U. S. Geol. Survey No. 374, 1909.

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of copper, or 20.93 per cent of the total output of the country, thus giving the Territory third rank among the copper-producing States. The Territory produced 27.52 per cent of the total output of the country for 1910.

Eleven copper-smelting plants operated within the Territory during the year.

The greater part of the production, as in previous years, was from four districts, though two other important districts were nearly ready to enter the producing class at the close of the year.

Bisbee district.—The Bisbee, or Warren, district in southern Cochise County, was the largest producer, with about 142,500,000 pounds of blister copper, as compared with 130,000,000 pounds in 1909. This was the largest output in the history of the district. Production began in 1880, since which time it has been a constant and increasingly important contributor to the output of copper. To the close of 1910 it had produced 1,285,000,000 pounds of copper, or 8.4 per cent of the output of the country and 39.3 per cent of the Arizona production. In total and in present output it ranks third among the copper districts of the country.

The Paleozoic [1] sediments of the district have been faulted and fissured and granite porphyry has been intruded in the form of stocks, dikes, and sills. The Sacramento Hill stock is the most prominent body of granite porphyry in the district, but in the mine workings dikes and sills of the porphyry are found extending into the limestones, and in the southern part of the district the porphyry masses are probably not directly connected with the Sacramento Hill mass, though both were doubtless derived from the same source. The ores occur replacing the limestone closely associated with the granite porphyry bodies, and also replacing the limestone along faults and fissures. So close is the association of ore and porphyry that in recent years prospecting has been guided to a considerable extent by this association. The presence of amphibole, pyroxene, garnet, vesuvianite, etc., associated with the ore minerals indicates a contact metamorphic origin of the ore bodies.

The primary ores are largely cupriferous pyrite carrying low values in copper. The workable ore bodies thus far developed have resulted from the concentration of the copper contained in the primary ores by the process known as "secondary enrichment." Under favorable conditions these secondary changes have extended to great depth. In the upper workings the copper is principally in the form of carbonate oxides and native copper. With increasing depth sulphide ores become relatively more important. The richer ores of the latter class have resulted from the partial replacement of the original ores by the richer secondary copper sulphides. Under favorable conditions, this enrichment has taken place to the greatest depth attained in mining developments.

In the early days the output of copper was entirely from oxidized ores, but in recent years the quantity derived from sulphide ores has rapidly increased and at the present time probably equals that derived from oxidized ores.

[1] For detailed geological report see Ransome, F. L., Geology and ore deposits of the Bisbee quadrangle, Arizona: Prof. Paper U. S. Geol. Survey No. 21, 1904; Rice, Claude T., Camp of Bisbee, Arizona: Mines and Methods, Salt Lake City, Utah, vol. I, 1909, p. 241.

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It is reported by the companies that additions of ore reserves in all the properties have fully equaled or exceeded extraction and in some cases most important developments have been made. This is especially true of the Junction shaft of the Superior & Pittsburg Co., where large bodies of unusually high-grade sulphide ore were developed in the 1,300-foot, 1,400-foot, and 1,500-foot levels. Sulphide ore of fair grade was encountered by this shaft on the 1,700-foot level, but the extent of the deposit has not been ascertained.

The nature of the deposits of the district do not favor the blocking out of extensive ore reserves far in advance of immediate needs, since the cost of keeping the heavy ground open for a long period is prohibitive. The quantity of ore actually blocked out in proportion to the annual output of copper is probably smaller for this district than for any large producing district in the country.

Most of the ore occurs in irregular bodies without definite arrangement, so that the cost of prospecting is greater than in many other districts. Moreover, the soft heavy ground associated with the ore makes it necessary to employ the square set method in mining, and the cost of timber adds materially to the cost of mining. Recently efforts have been made by both of the principal companies to modify their system of mining so as to use less timber. The cost of mining in the district, however, is likely to remain relatively high. Centralization and improvement in the hauling and hoisting systems of the mines has resulted in marked economy. The ores of the district continue to show a decrease in grade, but this is in part due to improvement in mining and metallurgical methods which permit the treatment of lower grade material. It is the policy of most of the companies to mine as low-grade ore as can be treated at a reasonable profit. In the early days of mining in the district the oxidized ores yielded about 20 per cent of copper. For 1910 the average recovery was about 5.43 per cent copper, with 0.0234 ounce gold and 1.07 ounces silver per ton, an average precious metal value of $1.07 per ton of ore.

The Copper Queen mine produced a total of 596,193 tons of ore and precipitate, containing 76,428,908 pounds of copper, 12,430 ounces of gold, and 608,097 ounces of silver.

The Calumet & Arizona mine produced 347,577 tons of ore, the ore as it came from the mine yielding an average of 4.175 per cent copper, which contained $18.93 in gold and silver per ton of refined copper.

The Superior & Pittsburg mine produced 256,490 tons of ore, yielding an average of 5.119 per cent copper as the ores came from the mine. The copper contained $17.98 in gold and silver per ton of refined copper.

The production of ore from the Shattuck-Arizona mine was larger than in previous years. According to the statement by the auditor of the Territory the mine yielded 14,751,000 pounds of copper.

At Douglas the smelting plants of the Copper Queen Consolidated Mining Co. and the Calumet & Arizona Mining Co. were operated throughout the year. Experiments were conducted and plans inaugurated by both companies looking to an increased recovery of flue dust. The Copper Queen Consolidated Mining Co. began the construction of an addition to the smelter to consist of a calcining and reverberatory plant to treat fine ores and flue dust. It will consist of 2 reverberatory furnaces and 6 calciners of the McDougal

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type, with the necessary bins to store concentrates, dust chambers, flues, and stacks.

In 1910 in addition to Copper Queen ores, the smelter treated the ores and concentrates of the Montezuma Copper Co., Mexico, and custom ores from Arizona and New Mexico.

The Calumet & Arizona Mining Co., has under consideration the entire remodeling of the old smelting plant or the construction of a new smelter. The increase in the percentage of sulphide ores produced has made a change in the metallurgical treatment of the ores desirable.

The district is served by the El Paso and Southwestern Railroad, controlled by Phelps, Dodge & Co. Oil for fuel is used extensively in the production of power, electric power being generated in central plants and distributed to the points where needed.

Toward the close of the year plans were perfected looking to a merger of the Calumet & Arizona Mining Co. and the Superior & Pittsburg Mining Co. These plans were consummated early in 1911, the stock of the Calumet & Arizona Mining Co. being increased to 650,000 shares and an exchange made for the stock of the Superior & Pittsburg Mining Co. on the basis of 1 share of Calumet & Arizona for 3½ shares of Superior & Pittsburg.

Morenci-Metcalf district.—The deposits of the Morenci-Metcalf district are at Morenci and Metcalf, in Greenlee County. During 1910 the district produced 73,154,000 pounds of blister copper as compared with about 72,000,000 pounds in 1909.

The district was one of the earliest copper producers in the Territory, the output beginning as early as 1873, and since 1880 it has been an important contributor to the copper output of the country. To the close of 1910, a total of 882,700,000 pounds of copper had been produced, or 5.77 per cent of the output of the country since 1845, and 27.58 per cent of the output of the Territory. In total production it ranks fourth among the copper districts of the country and second in the Territory. In the output for 1910 it ranks fifth in the country and second in the Territory.

The copper ores[1] of this district occur as contact deposits in Paleozoic limestones and shales which have been intruded by stocks and dikes of porphyry, as disseminated deposits mainly in the porphyry, and as deposits in fault fissures of the Coronado type.

The original ores were pyrite and chalcopyrite of too low grade to be of economic importance. The workable bodies have resulted from the process of secondary enrichment. The ore bodies in the limestone were formed in certain beds favorable to deposition and this produced roughly tabular bodies nearly parallel to the stratification of the limestone. Alteration of these bodies has produced oxidized ores which formed most of the workable ores in the limestone. These are now nearly exhausted.

The disseminated ores occur in highly altered porphyry adjacent to fissure veins. The copper content of the upper portion of these deposits has been leached and deposited as chalcocite on the pyrite lower down. This has produced a zone of commercial ore, varying in thickness, in general not extending below a depth of 400 feet.

[1] For detailed report of the Clifton-Morenci district see Lindgren, W., The copper deposits of the Clifton-Morenci district, Arizona: Prof. Paper U. S. Geol. Survey No. 43, 1905; Tovote. William L.. Min. and Sci. Press, vol. 101, 1910, p. 770.

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In the fault fissure or Coronado type of deposit, commercial ore has been developed to much greater depth, and recent exploration of the principal faults in Copper Mountain indicates that commercial ore may be found associated with these faults considerably below the general level of the ore zone.

Of the 1910 copper output, 51,082,689 pounds were derived from concentrating ores, and 22,072,280 pounds from smelting ores. The mines of the district produced 1,306,783 tons of concentrating ores, yielding 1.99 per cent copper, and 247,865 tons of smelting ore, yielding an average of 4.18 per cent copper, the average yield for the 1,554,648 tons of ore produced in the district being 2.35 per cent.

The ores in general carry low gold and silver values, and as much of the copper is of sufficient purity for commercial purposes it is not refined electrolytically, and consequently the precious metal content is not recovered.

Until recently the square set and fill system of mining which necessitated the use of large amounts of timber was very generally employed in the district. More lately modified systems of slicing and caving have been introduced and are being extended, so that at present a large percentage of the ore is extracted by these methods at a considerably reduced cost.

The district contains large reserves of ores, and developments during 1910 have considerably increased the reserves and added to the possibilities of ore in both the Morenci and the Metcalf sections of the district.

The Detroit Copper Co. reduced to bullion 497,250 tons of ore, yielding 23,591,021 pounds of copper, or 46.64 pounds per ton of ore. The average assay value of ore concentrated was 2.977 per cent of copper. An amount equal to 76.42 per cent of the content of the ore was recovered in concentrates. In the smelting and converting of ore and concentrates a recovery of 90.945 per cent of the copper content was made.

During the fiscal year ending September 30, 1910, the Arizona Copper Co. (Ltd.) produced 32,161,205 pounds of copper. The average yield in copper per ton of ore treated was 42.64 pounds, or 2.13 per cent. This compares with a yield of 2.15 per cent for the preceding year. Of the ore mined, 57.6 per cent came from the Longfellow group and 42.4 per cent from the Metcalf group. Of the total ores, 96 per cent were concentrating ores and 4 per cent smelting ores. Of the total copper production, 85 per cent was derived from sulphide ores and 15 per cent from oxidized ores.

For the fiscal year ending August 31, 1910, the smelter of the Shannon Copper Co. produced 16,565,032 pounds of copper from company ores and 1,045,233 pounds from custom ores. During the same period the mines of the company yielded 311,456 tons of ore.

Three smelting plants, those of the Arizona Copper Co. (Ltd.), and the Shannon Copper Co., at Clifton, and of the Detroit Copper Co., at Morenci, were operated during the year. These treated 239,765 tons of smelting ore, yielding 22,072,280 pounds of copper, and 214,933 tons of concentrates, yielding 51,144,045 pounds of copper.

The oxide concentrator of the Arizona Copper Co. (Ltd.) treated a large tonnage of ore and tailings, producing 11.3 per cent of the company's output for the fiscal year.

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The district is served by the line of the Arizona and New Mexico Railway Co. controlled by the Arizona Copper Co. A narrow gage line controlled by Phelps, Dodge & Co. extends from Morenci to connect with the Arizona and New Mexico Railroad at Coronado. Early in 1910 the Shannon Copper Co. completed a standard gage road connecting the mines at Metcalf with the concentrating and smelting works at Clifton.

Jerome district.—The Jerome or Verde district of Yavapai County, produced about 38,660,000 pounds of blister copper in 1910, as compared with about 36,700,000 pounds in 1909. The production of copper in the district began about 1883 though it had yielded gold and silver previous to that time. Since 1888 it has been a steady and important producer.

To the close of 1910 it has yielded a total of 570,000,000 pounds of copper, or 3.72 per cent of the total output of the country since 1845, and 17.8 per cent of the total output of the Territory. In total output it stands fifth among the copper districts of the country and third in Arizona. In output for 1910 the district ranks eighth among those of the country and third in the Territory.

According to Graton [1] the ore body of the United Verde mine is an irregular lenticular mass, replacing a schistose rock that has resulted from the intense sheering of a rather basic porphyry. The ore minerals, mainly sulphides of iron, copper, and zinc, have partly or completely replaced the rock in some instances; in others, they occur as veins and stringers in the schist. The ores are of pre-Cambrian age.

The ores differ from most of the large copper deposits of Arizona in carrying rather high gold and silver values. The copper content of the ore is also unusually high for this type of deposit.

As little timber as possible is employed in mining on account of the danger from fire.

Considerable copper is recovered from the mine waters that have leached through the burning stopes by precipitation on scrap iron.

Most of the ore is smelted at the United Verde Copper Co.'s plant. The ore high in sulphur is roasted and smelted in blast furnaces. Some of the ore low in sulphur is smelted without roasting.

It is reported that plans are now under consideration for the remodeling of the present smelting plant or the construction of a new smelter.

According to published figures, the United Verde Copper Co., the only important producer of the district, made an output of 38,663,880 pounds of copper, 563,133 ounces of silver, and 19,267 ounces of gold in 1910. The precious metal content was equivalent to about 1.8 cents per pound of copper.

Development was carried on by other companies in the district during the year, but no important production was made. The district is served by a narrow-gauge railroad owned by the United Verde Copper Co., which connects with the Santa Fe, Prescott & Phoenix Railway.

Globe district.—The Globe district of Gila County produced about 27,600,000 pounds of blister copper in 1910, as compared with about 33,000,000 pounds in 1909.

[1] Graton, L. C., Mineral Resources U. S. for 1907, pt. 1, 1908, p. 597.

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Production of copper began in the district about 1881; the camp was well known as a silver producer before that date. For several years subsequent to 1881 the production was intermittent, but since 1888, and especially since 1898 when the railroad reached the camp, the district has ranked among the important copper producers of the country. To the close of 1910 it has produced a total of 334,700,000 pounds of copper, or 2.18 per cent of the output of the country since 1845, and 10.45 per cent of the output of the Territory. In total production the district ranks eighth in the country and fourth in the Territory. For 1910 it ranks ninth in the country and fourth in the Territory.

The geology[1] of the district may be briefly summarized as follows: Paleozoic sediments, consisting of conglomerates, quartzites, shales, and limestones were laid down unconformably on a pre-Cambrian basement of schist and intruded granitic rocks. In post-Paleozoic time the region was invaded by an intrusion of diabase followed by an intrusion of granitic rock. After a period of erosion the area was partly or wholly buried beneath Tertiary volcanic and sedimentary rocks which have since been partly removed by erosion.

The copper deposits are believed to have been introduced at the time of or closely following the post-Paleozoic granitic intrusion, and the source of the copper-bearing solutions is believed to have been connected with this igneous rock. The deposits of the district are of quite different types, dependent largely upon the nature of the rocks in which they were formed. In the Globe end of the district the deposits occur as roughly lenticular deposits replacing limestone, and as fault lodes or fissure zones of quartz and sulphide in diabase.

In the Miami end of the district the ores occur mainly as small veins of quartz and sulphide in the shattered rock near the granite schist contact, the mineralization occurring in both formations.

Most of the ores developed to the present time owe their commercial value to secondary enrichment. The ore extracted from the limestone has been largely oxidized, and much of the ore developed in the diabase has been enriched sulphide. Under favorable conditions the sulphide enrichment has gone on to the greatest depth to which development has extended. Some bodies of primary ore of commercial grade have also been developed.

In the disseminated bodies of the Miami section the original ore was sulphides of iron and copper. The copper content of the ores near the surface has been largely taken into solution and redeposited as chalcocite on the sulphides lower down. The commercial ore consists of grains of pyrite and chalcopyrite partly or wholly replaced by chalcocite. The commercial bodies of ore are blanket-like deposits overlain by leached "sapping" and underlain by primary mineralization too lean in copper content to be classed as commercial ore.

An exceptional type of ore is that of the Black Warrior mine, which is oxidized ore cementing dacite tuff or breccia.

To the present time the main production has been from the Globe end of the district. In the last few years, however, large tonnages

[1] For detailed description see Ransome, F. L., Geology of the Globe copper district, Arizona: Prof. Paper U. S. Geol. Survey No. 12, 1903; Ransome, F. L., Geology at Globe, Arizona: Min. and Sci. Press, vol. 100, 1910, p. 256; Ransome, F. L., Geology of the Globe district, Arizona: Min. and Sci. Press, vol. 102, 1911, p. 747; Tolman, C. F., jr., Min. and Sci. Press, vol. 99, 1909, p. 646; Higgins, Edwin, Eng. and Min. Jour., vol. 89, 1910, pp. 766, 813, 870.

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of ore have been developed in the Miami section, and 1911 will see this section an important producer.

The ores of the district vary greatly in copper content, the grade to be treated at any given time depending largely on the possibility of profitable treatment. In general, ores of as low grade as can be handled with reasonable profit are mined. During 1910 the ores yielded about 5 per cent of copper, with about 33 cents in gold and silver per ton. Most of the ore from the district has been of smelting grade. During 1910 about one-third of the ore was concentrated about 3 to 1.

Two smelting plants were operated in the district during the year, the Old Dominion Copper Co.'s smelter, and the matte smelter of the Arizona Commercial Copper Co. The latter plant was closed April 17, 1910, and remained inactive for the remainder of the year.

The district is served by the Gila Valley, Globe & Northern Railway, a branch of the Southern Pacific. This line has been extended from Globe to the Miami district.

The Old Dominion and United Globe mines were the largest producers during the year.

The average copper content of ores mined by the Old Dominion Copper Mining & Smelting Co. was higher than in 1909. In 1910 smelting ores yielded 7.85 per cent copper and concentrating ores yielded 3.49 per cent. The average grade for both was 5.70 per cent, as compared with 4.8 per cent for the preceding year. The total cost of copper per pound was 10.16 cents.

In the United Globe mine extensive additions were made to the developed ore.

Production by the Arizona Commercial Co. ceased with the closing of its smelting plant in April, but development by this and other companies was continued in the Globe end of the district.

The Warrior Development Co., operating the Black Warrior mine, was the only important producer in the Miami end of the district in 1910. According to the company's report, the mine produced 27,320 tons of ore, with an average copper content of 9.66 per cent, yielding 5,295,529 pounds of copper. The ores mined up to the present have been oxidized ores in dacite tuff or breccia.

Development was continued at the Miami Copper Co.'s property. At the close of the year the company reported 18,000,000 tons of developed ore, averaging 2.58 per cent copper. The blocking out of the ore was carried on to the point where the mine was prepared, at the close of the year, to furnish a tonnage of ore equal to the capacity of the mill. The method of extracting the ores consists of a top-slicing and sublevel-stoping system, which has been described in some detail in the articles referred to.

The mill was nearly completed during the year and the first unit went into operation in March, 1911. The mill consists of six units, and has a nominal capacity of 2,000 tons per day, though it is expected that this will be exceeded in actual operation. Concentrates will be shipped to the Cananea Consolidated Copper Co.'s plant at Cananea, Mexico, for smelting.

Development of ore by churn drill and underground openings was continued by the Inspiration Copper Co. At the close of the year the company reported 15,994,000 tons of ore, with a copper content of 2.02 per cent, as fully developed, and 4,195,000 tons, with a copper

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content of 1.91 per cent, as partly developed, a total of 20,189,000 tons of developed and partly developed ore, with an average copper content of 1.997 per cent.

The ore is being blocked out preparatory to the employment of a modified form of the caving system in mining. An experimental mill was in operation at the close of the year to determine the best system of concentrating the ores, but definite arrangements for the construction of a mill had not been made.

Development was carried on at the Live Oak, Keystone, and other properties. The Live Oak Copper Co. reported, at the close of the year, 6,000,000 tons of developed ore, averaging 2.25 per cent copper, and 3,000,000 tons of the same grade partly developed.

Silverbell district.—The Silverbell district of Pima County made a production of about 5,750,000 pounds of blister copper in 1910, as compared with about 10,500,000 pounds in 1909.

Important copper production began in the district in 1904, though it had produced some silver and a little copper before that date. At the close of 1910 the district had produced about 41,800,000 pounds of copper.

Paleozoic sediments [1] have been intruded by an acid porphyry, the sedimentary formation for the most part being detached blocks entirely surrounded by porphyry. The copper deposits are of two types—contact deposits, in which the sulphides of iron and copper, together with contact silicates, garnet, epidote, etc., have replaced limestone; and disseminated deposits, in which the original ores consist of iron and copper sulphides as veinlets and small grains in the shattered porphyry. The commercial ores of the latter type in this district, as in most others, have resulted from the secondary enrichment of these deposits.

The ore mined to the present time has been principally that of the contact deposits. These ores are in general rather low-grade smelting ores. However, they are nearly or quite self-fluxing and can be treated cheaply. Development of disseminated ores has been in progress by several companies and encouraging results are reported, but there has been no important output from this type of ore.

The ores of the district are treated at the plant of the Southern Arizona Smelting Co., at Sasco. This plant was closed down August 16, 1910, and remained idle for the rest of the year.

A branch of the Southern Pacific Railroad extends from Red Rock to the district.

The Imperial Copper Co. was the main producer in 1910, as in previous years.

Mineral Creek or Ray district.—Development was continued in the Mineral Creek district, Pinal County, during the year.

This district has not been a large copper producer to the present time, but beginning with 1911 will take its place among the important copper districts of the country. The geology [2] of the district is very similar to that of the Globe district to the north. Paleozoic sediments have been deposited on a basement of pre-Cambrian schists. In post-carboniferous time the region was invaded by an

[1] The district has been briefly described by C. F. Tolman, jr., Min. and Sci. Press, vol. 99, 1909, p. 710.
[2] Ransome, F. L., Geology of the Globe district, Arizona: Min. and Sci. Press, vol. 102, 1911, p. 747; Weed, W. H., The Ray copper mining district, Arizona: Mining World, vol. 34, 1911, p. 53; Tolman, C. F., jr., Disseminated chalcocite deposits at Ray, Arizona: Min. and Sci. Press, vol. 99, 1909, p. 622.

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intrusion of diabase and later by a granitic intrusive of varying composition. After a period of erosion the area was buried beneath Tertiary volcanics and sediments. Later it was elevated, faulted, and the covering of Tertiary sediments partly removed. The ore deposits of the district are of two distinct types—those formed in the sedimentary rocks adjacent to faults and fissures, and disseminated deposits in the schist and granite. The ores of both types are believed to have been introduced at the time of and closely following the granitic intrusion.

The deposits of the first type are found east of the Ray fault. The ores are mainly oxidized. To the present time important production has not been made from this type, nor have large ore reserves been developed.

The disseminated deposits occur in crushed schist and granite. The original mineralization was pyrite and chalcopyrite, but the commercial ore has resulted from secondary enrichment of the deposits produced by the leaching of the copper values from the upper portion and redepositing them as chalcocite on the sulphides lower down. This has resulted in a blanket-like deposit of commercial ore covered by a relatively barren capping and underlain by a zone of original mineralization too low in copper content to be of commercial value. Locally, especially associated with the diabase, native copper becomes of some importance.

The district is served by the Arizona & Eastern Railroad. The mines and reduction work are connected by the Ray & Gila Valley Railroad, controlled by the Ray Consolidated Copper Co.

The most extensive operations in the district were conducted by the Ray Consolidated Copper Co., with which the Gila Copper Co. has been merged.

Development of ore by churn-drill methods and blocking out of the ore bodies preparatory to extraction were carried on through the year. On April 1, 1911, the company reported 64,831,000 tons of ore fully developed, and a total of 77,535,000 tons fully and partly developed, having an average copper content of 2.17 per cent. The ore is being blocked out with a view to mining by the "caving" system.

The reduction works of the company are located at Hayden, on the Arizona & Eastern Railroad, about 21 miles from the mine.

The mill will consist of eight units with an approximate capacity of 8,000 tons per day. The first unit of the mill went into operation March 15, 1911, and the remaining units will probably be in operation before the close of the year.

A smelting plant to reduce the concentrates is in process of construction at the same place, but will not be completed for some time. Previous to the completion of the smelter the concentrates will be shipped to El Paso.

Development of ore was carried on by the Ray Central Copper Co., which reported 7,500,000 tons of ore developed January 1, 1911. A test mill was operated by this company for a part of the year, but definite steps toward the erection of a permanent milling plant were not taken. Less extensive operations were carried on by other companies.

Other districts.—The smelter of the Arizona United Copper Co., at Johnson, Cochise County, was active for a part of the year. At

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Humboldt, Yavapai County, the smelter of the Consolidated Arizona Smelting Co. was operated the latter part of the year, receiving part of its ores from the United Verde mine. The Clara Consolidated Gold & Copper Mining Co.'s smelter at Swansea, Yuma County, was in blast for a short period. Shipments were continued from the Courtland district, Cochise County, but this district has not proven as productive as was at first hoped. During 1910 it yielded about 2,850,000 pounds of copper.

Several small smelters in the Territory that were active in 1906 and 1907 have been unable to operate since the decline in the price of copper.

CALIFORNIA.

In 1910 California produced 45,760,200 pounds of blister copper, as compared with 53,568,708 pounds for 1909. The reduction in output for the State is due to the necessity of eliminating from the smelter smoke ingredients injurious to vegetation. This resulted in a decreased output by all of the smelters of the Shasta County district and the closing down of one. The same cause will further restrict the output for 1911.

California was among the earliest of the Western States to make an important output of copper. Production began in the "Foothill" belt about 1862 and for several years was an important industry, California being second only to Michigan in its copper production. In a few years, however, the industry declined, and California did not have important rank as a copper producer until 1897, when production from the Shasta County district began. Since that time there has been a steady and important output from the State. The production for the early years has been ascertained from the best sources available, and adding to this the known production since 1882, it is found that to the close of 1910 California has produced about 445,000,000 pounds of copper, or 2.91 per cent of the output of the country since 1845. In 1910 the output was 4.23 per cent of the total production of the United States. In total output the State ranks fifth among the copper producers and for 1910 it ranked sixth.

Seven plants in the State treated copper ores in 1910, though several of these were operated for only a short period, and the two largest plants made reduced outputs.

The main production has come from two districts, though numerous other districts have made small outputs, and copper minerals are widely distributed over the State. The largest producer has been the Shasta County district and the next most important the "Foothill" district.

Shasta district.—The Shasta County copper belt is situated in the Klamath Mountains, at the head of the Sacramento Valley, a few miles north of the town of Redding. Sacramento River crosses the belt, separating it into an eastern and a western portion, the eastern portion containing the Bully Hill and the Afterthought districts; and the western, the Iron Mountain and the Little Backbone districts. Placer mining was carried on in the district in the early days of mining in the State, and later considerable silver was produced from the gossan outcrop of the copper deposits. Although copper minerals have been long known from the district, it was not until 1897, when the Mountain Copper Co. (Ltd.), began production at Iron Mountain,

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that it became an important contributor of copper. In 1910 the district produced about 36,000,000 pounds of copper, as compared with about 48,000,000 pounds in 1909. The total production to the close of 1910 has been about 336,000,000 pounds, or about 2.19 per cent of the total output of the country. In 1910 the district produced about 3.33 per cent of the total output. In total output the district ranks seventh, and in the production for 1910 it ranked eighth among the copper districts of the country.

The inclosing rock[1] of most of the ore bodies is an alaskite porphyry intrusive of Mesozoic age. The ore minerals have replaced this rock along zones of shearing. In the western district the ores thus far developed are large, flat lying, more or less tabular bodies of no great vertical extent. In the eastern district they have more the character of veins and, locally, form deposits in the adjoining sediments. The ore in the western district is pyrite, with a small percentage of chalcopyrite and varying amounts of sphalerite. In the eastern district sphalerite becomes an important constituent.

Rich secondary sulphide ores were found underlying the gossan at Iron Mountain and Bully Hill, but these have been exhausted

The ores carry values in precious metals, those of the eastern district being rich in them. The average metal content of ores treated from the district for 1910 was 3 per cent of copper, with 0.0571 ounce gold and 1.78 ounces of silver per ton, a precious metal value of $2.14 per ton. The combined precious-metal content is equivalent to 3.56 cents per pound of copper. A large tonnage of ore is blocked out in the mines of the district.

The producing companies in 1910 were the Mountain Copper, Balaklala, Mammoth, and Bully Hill companies. All of the ore is smelted in the district, except that of the Mountain Copper Co., which during 1910 was treated at its Martinez plant on San Francisco Bay. In addition to local ores, the smelters treated ores from Nevada, Utah, and Oregon, and ore and matte from other districts of the State. A large tonnage of the low-grade gold quartz ores of the districts was used by the smelters of the western district to flux their ores. The pyritic process of smelting is practiced successfully throughout the belt. In the eastern district hot blast is used in the smelting of ores which are high in zinc.

Three smelters were operated in the district during 1910: The Mammoth smelter of the Mammoth Copper Mining Co., at Kennett, the Bully Hill smelter of the Bully Hill Copper Mining and Smelting Co., at De Lamar, and the Balaklala smelter of the First National Copper Co., at Coram.

The smelting plant of the Mammoth Copper Mining Co. was operated throughout the year. In order to remove ingredients of the smelter smoke injurious to vegetation, the Mammoth Co. constructed a bag house similar to the one in operation at the Midvale plant, Utah. This was put into operation July 5, 1910, and is reported to be entirely successful in removing objectionable substances from the smoke, but the capacity permitted the operation of only two of the four furnaces during the summer months. With the addition of fans and sprays

[1] Diller, J. S., Redding folio (No. 138), Geol. Atlas U. S., U. S. Geol. Survey, 1906; Bull. U. S. Geol. Survey No. 213, 1903, pp. 123–132; Bull. U. S. Geol. Survey No. 225, 1904, pp. 169–179. Graton, L. C., The occurrence of copper in Shasta County, Cal.: Bull. U. S. Geol. Survey No. 430, 1910, p. 71.

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for cooling the gases, the capacity has been increased so that three furnaces can be operated. At the company's mine 330,633 tons of ore was extracted, and it is reported by the company that a tonnage of ore fully equal to that extracted was developed. The Balaklala Copper Co. installed a Cottrell process plant for clearing the fumes. This process has not proved entirely successful, as the smelting plant could be operated at only part capacity, and even then the fumes were not freed sufficiently from injurious substances to meet the requirements of the court's decree, and the plant was ordered to be closed in July, 1911. It is hoped that the plant may be perfected and accomplish the purpose for which it was designed.

The Bully Hill Co. has not installed a plant for treating the smelter fumes, and consequently was closed in July, 1910. It is reported that the company is conducting experiments with a view of developing a process by which it can treat the ores without injury to vegetation.

In view of the difficulties experienced in handling the smelter-smoke problem, it is not likely that the district will show an increase in production in 1911; in fact, there will likely be a further falling off.

Electric power is used almost exclusively at both mines and smelters.

The district is served by the Southern Pacific Railroad, short branches extending to the smelters. The Iron Mountain district is connected with the main line by a narrow-gauge railroad operated by the Mountain Copper Co., and the mines of the Mammoth Co. are connected with the smelter by a combined electric railroad, gravity tram, and steam railroad. The ores of the Balaklala mine are delivered to the smelter over a cable tramway.

"Foothill" district.—The "Foothill" belt is a rather extensive area of copper deposits which has its best development in Calaveras County. This belt furnished practically the entire copper production from California in the sixties. Following that period of activity, the district was inactive for many years. From 1887 to 1892 the mines made some production. The present period of activity began about 1901, and for some years the district has made important contributions to the copper output of the State.

There is no accurate record of the output of this district in the early days, but from the records of the production of the State it is estimated that to the close of 1910 it has yielded approximately 104,000,000 pounds of copper. The production for 1910 was approximately 8,000,000 pounds. In total output and in production for 1910 the district ranks eleventh among the copper districts of the country.

The ores,[1] consisting of pyrite and chalcopyrite, occur as lenticular bodies replacing schist. The ores vary in different parts of the district from those carrying nearly pure pyrite and chalcopyrite with very low gold and silver content to ores carrying considerable lead, zinc, and precious metal. The ores treated in the district during 1910 averaged about 5.2 per cent in copper, with about 2.3 cents in precious metal per pound of copper.

The matte smelter of the Penn Chemical Co. was operated in the district, and ore was shipped to custom smelters.

[1] Knopf, A., Bull. Dept. Geology Univ. California, vol. 4, p. 411; Read, J. A., Econ. Geology, vol. 2, 1907, p. 380; Lang, Herbert, Eng. and Min. Jour., vol. 84, 1907, p. 909.

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COLORADO.

In 1910 Colorado produced 9,307,497 pounds of blister copper, as compared with 11,485,631 pounds in 1909. Although the State has no important producing district in which copper is the principal metal, yet it ranked eighth among the copper-producing States in 1910. The total recorded output for the State from the beginning of the industry has been 203,752,063 pounds, or 1.33 per cent of the total output for the United States since 1845. It is probable that the actual output is somewhat in excess of this figure, as some of the copper assigned in the earlier Survey reports to "lead desilverizers" should doubtless be credited to Colorado.

The main production has been derived from the treatment of mixed ores in which copper was of minor importance, including lead-silver ores and pyritic ores rich in gold and silver. The largest production in 1910, as in previous years, was from Lake County and from San Juan, Hinsdale, Ouray, San Miguel, Clear Creek, and Gilpin counties. Leadville and the San Juan-Ouray districts have been the greatest producers of copper.

Most of the output is recovered as matte in lead furnaces, though two copper smelters, the Boston & Colorado, at Denver, and the plant of the Modern Smelting & Refining Co., at Utah Junction, were operated for a portion of the year.

The year witnessed the dismantling of the plant of the Boston & Colorado Smelting Co. and the passing of this pioneer in the copper-smelting industry of the West. Although this company has been successful in its long period of operations, the management did not consider it wise to rebuild the plant, which was becoming out of date. This pioneer plant has had a long and successful career, but copper smelting plants constructed in the State in recent years have been far less successful and have been able to operate but intermittently.

IDAHO.

During 1910 Idaho produced 6,877,515 pounds of blister copper, as compared with 7,096,132 pounds in 1909. The State has made a small and irregular output of copper since 1884, but only since 1903 has it been a steady and important producer. To the close of 1910 it had a recorded output of 54,557,684 pounds.

The Cœur d'Alene district furnished most of the copper output for 1910 and has been the most productive copper district in the State. Complete figures for the copper output of the district are not on record but the total production has been approximately 43,000,000 pounds.

The Snowstorm mine is the most important copper producer of the district. This deposit [1] consists of disseminated bornite, chalcocite, and chalcopyrite in certain beds of a pre-Cambrian quartzite; in the upper portion the deposit is oxidized. The lode varies from a few feet to 40 feet in width, and has been developed to a depth of 1,200 feet below the outcrop. Development is by tunnels. The ore, being highly siliceous, is well adapted for converter linings and consequently receives favorable smelting rates. The shipping ore yields

[1] Ransome, F. L., and Calkins, F. C., The geology and ore deposits of the Coeur d'Alene district, Idaho: Prof. Paper U. S. Geol. Survey No. 62, 1908, pp. 150–152.

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3.5 to 4 per cent copper with about 6.5 ounces of silver and a little gold per ton.

The Elder district in Custer County made a considerable production in 1910, and the State contains other promising copper deposits, but owing to lack of development or poor transportation facilities, they have not been active since the decrease in the price of copper in 1907.

MICHIGAN.

The production of copper in Michigan in 1910 was 221,462,984 pounds, as compared with 227,005,923 pounds in 1909. The decrease in output was due entirely to voluntary curtailment resulting from the general condition of the market. The mines were capable of making a record production.

The mining of copper in Michigan antedates the earliest visits of European explorers to the region. The production on a commercial basis, however, dates from 1845, since which time the district has been a steady producer and an important factor in the copper industry of the world. To the close of 1910 Michigan has produced 4,756,420,142 pounds of copper, or 31.1 per cent of the output from the United States since 1845. For many years subsequent to 1845 Michigan was the most important copper-producing State and in total output is second only to Montana. The entire output is from the Keweenaw or Lake Superior district.

In the value of metal output, in the profits resulting from this output, in the development of mining and metallurgical processes, and in the general high standing of the companies conducting the operations, the district takes high rank among the great mining camps of the world. Previous to the perfection of the electrolytic process of refining, "Lake" copper enjoyed the distinction of being the highest grade produced, and even to the present time it sells at a figure slightly higher than the copper from other districts.

Although the district has been an active producer for 65 years, most of the older mines still have large reserves of ore and new mines are being opened, while much territory remains to be prospected. Moreover, it is claimed that a large tonnage of the mill tailings produced when milling methods were less efficient than at present can be re-treated at a profit.

Perhaps the most important developments of the last few years are those in the southern part of the district where the Lake mine and neighboring properties have disclosed what may prove to be large bodies of ore in a section of the district that hitherto has been less promising than the more fully developed area to the north, the deposits of this section are, however, characteristically "bunchy" and further development will be necessary to prove their value. Although the exhaustion of some of the older mines is in sight, yet it seems probable that the district has as long a life before it as any producing district in the United States.

The Lake Superior region is unique in being the only district from which a large output is derived from native copper. The rocks [1] of the district comprise a thick series of rather basic lava flows and

[1] For detailed description of the Keweenaw series see Irving, R. D., Mon. U. S. Geol. Survey, vol. 5; Geol. Survey Michigan, vols. 5 and 6; Rickard, Eng. and Min. Jour., vol. 88; Pumpelly, Raphael, Geol. Survey Michigan, vol. 1, 1873; Lane, A. C., and Hubbard, L. L., Geol. Survey Michigan, vol. 4, 1898; Reminger, C., Geol. Survey Michigan, vol. 5, 1906.

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intercalated beds of conglomerate and sandstone of pre-Cambrian age. These have been tilted so that they have a northwest dip, usually rather steep, and strike in a general northeast-southwest direction. The copper occurs in the cellular portion of the lava flows, which form the amygdaloid lodes, and as a cement and to some extent a replacement of the conglomerate pebbles forming the conglomerate lodes. Copper also occurs in fissures crossing the formations, but at present these are of little commercial importance, though in the early days of the district considerable copper was derived from this type of deposit. A little native silver occurs with the copper. The lodes are of low grade, but characterized by great extent and rather uniform distribution of the metallic content. This, together with the fact that the ore is susceptible of high concentration with low cost of refining the resultant "mineral," makes it possible to work these low-grade deposits at a good profit. The native copper occurs in the lodes in masses varying from microscopic size to bodies weighing hundreds of tons. The richest lode mined at present carries but 1.5 per cent copper, and the poorest rock treated yields but little above five-tenths of 1 per cent of metal. For this low-grade ore to be profitable it must be handled on a large scale; this has resulted in the construction of the immense plants that characterize the Lake district. The lodes are worked for the most part through inclined shafts, though some of the deeper deposits are opened by vertical shafts. The workings have been extended in some cases to a mile in vertical depth, or about a mile and a half down the lode. Pillars of rock are left to keep the lodes open, and dry walls constructed from the waste sorted underground serve the same purpose in some of the mines. Much timber, however, is required in some of the mines, especially those operating on the conglomerate lodes.

The rock coming from the mines is crushed by steam stamps and concentrated, producing "mineral" containing an average of about 62 per cent copper. This is subjected to a combined smelting and refining process. A small amount of "mass" and "barrel work" copper are sorted out at the mine and go direct to the smelter. A portion of the output is refined electrolytically; this consists of copper sufficiently argentiferous to make the recovery of silver profitable, and of copper containing so high a percentage of impurities that further refining is necessary for certain uses. During 1910 slightly over 15 per cent of the output was refined electrolytically.

Silver in important amount is recovered only from the copper treated electrolytically. The average recovery per ton of rock from which the copper was refined electrolytically was approximately 0.2176 fine ounce.

In the following table is given the production of individual companies compiled from their annual reports, together with the cost of production and the price received for the copper. The average cost of production for the district was approximately 9.857 cents per pound, and the average price received was 12.993 cents per pound, or an average profit of 3.136 cents per pound.

Approximately 20,000,000 pounds of copper, about 9 per cent of the total, was produced at a loss, more than one-half of this being produced by the Tamarack Mining Co. and a considerable part of the remainder by companies that are still in the development stage.

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Production of copper by Michigan mines for 1909 and 1910, in pounds, compiled from the annual reports of the producing companies.[a]

Company.	1909	1910	Cost per pound, 1910.	Price received per pound.	Profit (+) or loss (−).
	Pounds.	*Pounds.*	*Cents.*	*Cents.*	*Cents per pound.*
Ahmeek	9,198,110	11,844,954	11.05	12.94	+1.89
Alloues	4,031,532	4,655,702	11.57	12.67	+1.10
Baltic	17,817,836	17,549,762	8.32	12.74	+4.42
Calumet and Hecla	80,096,995	72,059,545	8.96	13.20	+4.24
Centennial	2,583,793	1,572,566	14.48	12.83	−1.65
Champion	18,005,071	19,224,124	7.85	12.74	+4.89
Franklin	1,615,556	966,353	14.63	13.07	−1.56
Gratiot	.....	265,369	.....	.....	.....
Isle Royale	5,719,056	7,567,399	11.84	12.65	+ .81
La Salle	.....	472,100	.....	.....	.....
Mass	1,723,436	1,321,385	.....	.....	.....
Michigan	1,979,305	.....	.....	.....	.....
Mohawk	11,248,474	11,412,066	11.44	13.09	+1.65
Osceola	25,296,657	19,346,566	9.37	13.00	+3.63
Quincy	22,511,984	22,517,014	10.48	13.21	+2.73
Superior	1,781,315	3,181,041	14.29	12.63	−1.66
Tamarack	13,533,207	11,063,606	14.70	12.97	−1.73
Trimountain	5,282,404	5,694,868	12.17	12.74	+ .54
Victoria	1,062,218	1,164,564	.....	.....	.....
Wolverine	9,757,101	9,617,168	7.542	12.58	+5.04
Average	.....	.....	9.857	12.993	+3.136

[a] Since this table includes mines reporting their output both for the calendar and for the fiscal years, and since some of the companies report the refined copper equivalent of mineral produced and others report refined copper, the amounts do not necessarily agree with the total of either mine or the smelter output.

The average copper yield per ton of rock milled during 1910 was 20.5 pounds, the same as for 1909. The average copper recovery from conglomerate rock for 1910 was 28.3 pounds per ton and for amygdaloid 18.2 pounds per ton. The copper derived from the two types, respectively, was 31.4 and 68.6 per cent.

During 1910 the rock milled amounted to 10,869,561 tons, as compared with 11,429,394 tons for 1909.

The change in grade of ore handled by the Lake companies is shown in the following table. The figures are compiled from the annual reports of the companies.

Tonnage and yield of ore milled by Michigan copper companies in 1909 and 1910, compiled from the annual reports of the producing companies.

Company.	1909		1910	
	Tonnage.	Yield per ton.	Tonnage.	Yield per ton.
Ahmeek	406,045	22.07	530,365	22.33
Alloues	253,049	15.93	247,119	18.84
Baltic	814,260	21.88	781,419	22.46
Calumet and Hecla	2,842,880	28.18	2,795,514	25.77
Centennial	196,525	13.15	102,133	15.40
Champion	753,908	23.88	722,051	26.62
Franklin	170,546	9.47	113,859	8.49
Gratiot	.....	.....	28,522	9.32
Isle Royale	401,280	14.30	520,860	14.53
La Salle	.....	.....	35,520	13.29
Mass	139,404	12.36	90,747	14.59
Michigan	146,971	13.47	.....	.....
Mohawk	819,019	13.73	802,537	14.22
Osceola	1,494,845	16.90	1,217,720	15.90
Superior	81,641	21.82	140,514	22.64
Tamarack	699,099	19.60	525,554	21.10
Trimountain	323,408	16.33	317,299	17.95
Victoria	.....	.....	122,497	9.51
Wolverine[a]	390,837	24.96	388,476	24.75

[a] Figures are for fiscal year ending June 30, 1911.

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The district is well located for cheap working of the mines. The Great Lakes furnish cheap transportation for both coal and copper, the Lake transportation being brought into the heart of the district by Portage Lake and the Houghton ship canal. The district is served by the Mineral Range, Copper Range, and Keweenaw Central Railroads and is connected with the main lines of traffic by the Chicago, Milwaukee & St. Paul and the South Shore & Atlantic Railroads.

Toward the close of the year steps were taken to effect a consolidation of the Calumet and Hecla interests with a view to more economical and efficient development and working of the properties than has been possible with the individual units. It is proposed to consolidate the following properties: Calumet and Hecla, Seneca, Ahmeek, Allouez, Osceola, Centennial, Tamarack, Laurium, La Salle, and Superior.

MONTANA.

The output of blister copper from Montana in 1910 was 283,078,473 pounds, as compared with 314,858,291 pounds in 1909. The State thus again ranks second to Arizona in copper production.

The first record of production of copper from Montana is for 1868, but the State did not become an important contributor of this metal until 1880. Since that time there has been a steady and rapid increase in the copper output. To the close of 1910 the State has yielded 5,326,439,393 pounds, or 34.83 per cent of the total output of the United States since 1845. In total production the State ranks first and in the output for 1910 it ranked second. The Butte district has furnished nearly the entire output of the State.

Four copper-smelting plants were operated in the State in 1910: The plant of the Colusa-Parrot Mining & Smelting Co., at Butte; the smelter of the East Butte Mining Co., at the same place; the smelter of the Washoe Copper Co., at Anaconda; and the smelter of the Boston & Montana Copper Co., at Great Falls.

Butte district.—In 1910 the Butte district, Silver Bow County, produced about 282,500,000 pounds of copper, or about 26 per cent of the total output of the country.

The presence of copper minerals in the district has been known since the discovery of gold in 1864, and attempts were made to treat the ores as early as 1866; but it was not until the late seventies that the district began to attract attention as a copper camp, and large production did not begin until a railroad reached the district in 1881. To the close of 1910 the Butte district has produced about 5,315,000,000 pounds of copper, or 34.75 per cent of the total output of the country since 1845. In total production and in the output for 1910 it ranks first among the copper-producing districts of the United States.

The copper ores [1] of the district occur as replacement veins in a granitic rock known technically as quartz monzonite. These veins form complex systems of slightly different ages.

The principal original ore minerals in the copper veins are pyrite, chalcopyrite, enargite, bornite, chalcocite [2], with varying amounts of sphalerite. It has been generally considered that the commercial ore

[1] Weed, W. H., Bull. U. S. Geol. Survey No. 285, 1905, p. 112. Weed, W. H., Geology and ore deposits of the Butte district, Montana: Prof. Paper U. S. Geol. Survey No. 74 (in press).
[2] Sales, Reno H.: Econ. Geology, vol. 5, 1910, p. 661.

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has resulted from the process of secondary enrichment and that the original mineralization was too low in copper content to be of commercial importance; but more recently the geologists of the district have considered that all the ore minerals in the deeper levels are of primary origin—that is, that they were deposited from ascending solutions, and that only the upper part of the deposit has been effected by secondary enrichment resulting from descending solutions. This conclusion, however, does not appear as yet to have been generally accepted and a more detailed description and discussion of the facts on which it is based than has yet been published is highly desirable. The ores may be divided into two general classes as regards treatment: The sulphide-quartz smelting ores, and the concentrating ores consisting of altered quartz monzonite impregnated with grains of sulphide. In the early days of mining in the district chalcocite was by far the most important copper mineral. With increase in depth of the workings, however, the amount of copper derived from enargite has increased until it probably nearly equals the amount derived from chalcocite.

The grade of ore mined in the district is regulated to a considerable degree by the possibility of profitable treatment. An increase in the price of copper or a decrease in the cost of mining and treatment permits the mining of lower grade ores. In 1910 the average yield was 3.13 per cent copper, as compared with 3.08 per cent in 1909 and with 3.3 per cent in 1908. In 1910 smelting ores averaging 5.68 per cent copper furnished about 22 per cent of the output derived from ores, and concentrating ores averaging 2.78 per cent furnished about 78 per cent. The ores averaged 2.02 ounces silver and 0.0068 ounce gold per ton, the precious metal content reducing the cost of copper nearly 2 cents per pound.

Early in the year steps were taken to combine the Amalgamated interests in the district under one company with a view to decreasing the cost of production by working them as one property and to eliminate the vexing question of the ownership of ore bodies. The stock of the Anaconda Copper Co. was accordingly increased and exchange was made for the stock of the Boston & Montana Copper & Silver Mining Co., Red Metals Mining Co., Washoe Copper Co., Butte & Boston Consolidated Mining Co., Big Blackfoot Mining Co., Trenton Mining & Development Co., Parrot Silver & Copper Co., Alice Gold & Silver Mining Co., and the Diamond Coal & Coke Co. The copper properties of W. A. Clark, including the Butte Reduction Works, which were closed down, were also purchased. The ore from these properties went to the other smelters of the company for treatment.

During the year the use of electric power was being extended. Hoisting by means of compressed air produced by electric power was put in operation at the Mountain View mine in 1911, and further extension of electric power for pumping, hoisting, and underground haulage is planned.

The reduction works at Anaconda and Great Falls treated a total of 4,337,688 tons of ore and other cupriferous material, yielding 266,608,461 pounds of copper, 9,534,888 ounces of silver, and 57,259 ounces of gold.

The greatest amount of development by the North Butte Mining Co. was on the Jessie vein, where the management reports opening

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a large body of ore on the 2,000-foot level and a good amount of ore on the 2,200-foot level. In sinking the Speculator shaft high-grade bornite and chalcocite were encountered at a depth of 2,740 feet. During the year the company produced 408,528 tons of ore, and at the end of the year ore in sight was reported as 958,680 tons of an average assay value of 4.25 per cent copper and 3 ounces of silver per ton. The total average cost per pound of copper for the year was 10.356 cents.

The East Butte Copper Mining Co. operated the Pittsmont smelter and its mines during the year. The management reports the development of an important ore body on the vein known as No. 824. During the fiscal year ending March 31, 1911, the company produced 85,876 tons of ore assaying 5.51 per cent copper, and the smelter shipped 11,417,904 pounds of copper, 432,218 ounces of silver, and 13,119 ounces of gold.

The district is served by three trunk lines of railroad, and a private standard-gage line connects the mines with the Washoe smelter at Anaconda. Much of the timber used in the district comes from the extensive timber lands controlled by the Amalgamated Co. Coal is also largely derived from the mines owned by this company in Montana and Wyoming. For power purposes electric power derived from Missouri River and other streams is largely replacing steam power.

NEVADA.

The production of blister copper in Nevada in 1910 was 64,494,640 pounds, as compared with 53,849,281 pounds in 1909, the increase being from the Ely district.

The earliest record of the production of copper in Nevada was for 1873, but it did not become an important factor in the copper industry until 1908, when production from the Ely district began.

To the close of 1910 the State has a recorded production of 137,939,097 pounds, or 0.9 per cent of the output of the country since 1845. To this should probably be added a small but unknown quantity produced as bluestone in the early days of mining in the State and used locally in the treatment of gold ores. In total production Nevada ranks eighth and in the output for 1910 fifth among the copper-producing States.

Ely district.—The Ely district, White Pine County, was the only important producing district in the State in 1910. Although it has long been known that the district contained copper deposits, active development on an important scale began but a few years ago and important production did not begin until 1908, when the Steptoe Valley smelter and concentrating plant was completed.

During 1910 the district produced about 63,800,000 pounds of blister copper, and to the close of 1910 the output has been about 125,000,000 pounds. The district has yielded 0.81 per cent of the total output of the country since 1845 and 5.9 per cent of the production of 1910. In total production it ranks tenth and in the production for 1910, sixth among the copper districts of the country.

The district is in the Egan Range, the geology [1] of which may be summarized as follows: Paleozoic limestones and shales have been

[1] Lawson, A. C., Bull. Dept. Geology Univ. California, No. 4, p. 284. A detailed report on the district is in preparation by the United States Geological Survey.

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invaded by a granitic intrusive technically known as quartz monzonite porphyry. Later the area was buried beneath lava flows which have been in large part removed by erosion.

The copper ores are of two types, replacement deposits in limestone near the porphyry contact and disseminated deposits in porphyry. The deposits in limestone thus far developed have been principally oxidized ores, and there has been but small production from this type. In the disseminated type the original ores consisted of small veinlets and grains of pyrite and chalcopyrite disseminated through the greatly shattered and highly altered porphyry. The commercial ore has resulted from the secondary enrichment of these deposits by the removal of the copper from the upper portion and redeposit as chalcocite on the sulphides lower down, the commercial ore consisting of grains of pyrite and chalcopyrite partly or entirely replaced by chalcocite. The leached capping is of varying thickness, but for a part of the deposit it is thin enough to permit of its removal and the mining of the ores by steam shovels; for the remainder underground methods will be employed.

During the year 2,346,354 tons of copper ore mined in the district produced concentrates containing 62,332,419 pounds of copper. The average recovery in concentrates per ton of ore from the district was copper 1.3 per cent, with about 21 cents in gold and silver per ton of ore. Smelting ores amounting to 28,325 tons contained 2.77 per cent copper, with 60 cents in gold and silver per ton.

The Nevada Consolidated Copper Co. and the Giroux Consolidated Mines Co. were the most active operators in the district, the production being mainly by the former company.

The production of the Nevada Consolidated Copper Co. for 1910 was almost entirely from the Copper Flat pit, though the Liberty area was partly stripped and prepared for production of ore in 1911. The ores were treated at the company's concentrating and smelting plant at McGill.

The company reported as developed during the fiscal year ending September 30, 1910, a total of 14,500,555 tons of ore, averaging 1.28 per cent copper, with a total of 40,360,828 tons developed reserve capable of extraction, averaging 1.70 per cent copper.

The following table gives the results of operations of the company during the fiscal year:

Results of Nevada Consolidated Copper Co.'s operations for fiscal year 1910.

Ore treated (dry)	short tons..	2,237,028
Average copper assay	per cent..	2.06
Extraction of copper	do....	69.59
Ratio of concentration		10.6 to 1
Assay value in gold	ounces..	.0181
Assay value in silver	do....	.0879
Extraction of gold	per cent..	49.78
Extraction in silver	do....	48.36
Average gold and silver recovered per ton of ore	cents..	21.14
Average copper in concentrates	per cent..	15.21

Operations of the Giroux Co. were confined to development. Work was continued on the new shaft and connections to open the ore bodies found on the 1,000-foot and 1,200-foot levels in the old Alpha shaft, and these should be reached early in 1911. Development of disseminated deposits by churn drill was continued, and at the close of the year

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the management reported as developed 9,620,000 tons of ore, averaging 1.36 per cent copper and 40 cents in gold and 20 cents in silver per ton. It is expected that the company will enter the producing class in 1911.

The district is served by the Nevada Northern Railroad, controlled by the Nevada Consolidated Copper Co., connecting with the Central Pacific Railroad at Cobre.

All the raw material for smelting operations except fuel are from the district. Siliceous ore is obtained from the "dike" of siliceous copper ore in the Copper Flat pit, and limestone for fluxing is quarried near the smelter. Coal as a fuel is being replaced by oil.

Yerington district.—At the Yerington district in Lyon County development was continued during the year, but no important production was made.

Copper ores have been mined in the district for many years. In the early days considerable natural bluestone was mined and used in the treatment of gold ores at Virginia City. Later an attempt was made to smelt the ores, but with little success. No accurate data of the total output of the district has been compiled, though it has not been large. During the last few years development of ore by several companies has been in progress and it is reported that considerable ore carrying copper values of 3 per cent or better have been opened.

The ores of the district according to Ransome[1] are of three types of occurrence:

(1) Irregular bodies formed by metasomatic replacement of limestone and genetically associated with metamorphism of a kind usually attributed to contact action of intrusive rocks; (2) metasomatic vein deposits in altered limestone; and (3) metasomatic vein deposits in granodiorite.

The most important developments are of ore bodies of the first type. The original sulphides of these are pyrite and chalcopyrite in various proportions, with a gangue of pyroxene, amphibole, epidote, garnet, and calcite.

During the year ground was broken for the construction of an 800-ton smelter near Wabuska by the Mason Valley Mines Co., but this smelter will not be completed before late in 1911.

The district is served by the Nevada Copper Belt Railway, which connects with the Goldfield branch of the Southern Pacific at Wabuska.

A small production was made from several other districts in the State, mostly from lead-copper and siliceous ores.

NEW MEXICO.

The production of blister copper in New Mexico in 1910 was 3,784,609 pounds, as compared with 5,031,136 pounds in 1909.

Production of copper from New Mexico began in the last years of the eighteenth century, native copper from the mines of Grant County being carried to Mexico City and coined into money. A little copper is reported for about the year 1860, but the Territory did not have a steady output until after 1880 and did not become an important factor in production until 1900. From 1845 to 1910 the Territory has a recorded output of 92,323,163 pounds of copper, or 0.6 per cent of the output of the country since 1845. The principal production has been from the districts in Grant County.

[1] Ransome, F. L., The Yerington district, Nevada: Bull. U. S. Geol. Survey No. 380, 1909, p. 99.

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Santa Rita district.—The Santa Rita district in Grant County made a production of about 2,670,000 pounds of copper in 1910, as compared with about 3,300,000 pounds in 1909. This was probably the first district in the West from which important copper production was made, the output beginning in the closing years of the eighteenth century, and the metal going to Mexico for coinage. There are no accurate records of the production for this early period of operation, but from the best sources available it is estimated that the total production to the close of 1910 has been approximately 103,000,000 pounds.

The geology [1] of the district is rather complex. The sedimentary series, consisting of quartzite, shales, and limestone, has been invaded in post-Cretaceous time by a granitic rock technically known as quartz monzonite porphyry. After a period of erosion the area was buried beneath Tertiary volcanic flows, which in turn have been largely removed by erosion.

The copper deposits may be divided into two types, contact deposits and disseminated deposits. The contact deposits occur as replacement of limestone near the porphyry contact and have been most extensively worked in the Hanover end of the district.

In the disseminated deposits the ore minerals occur as small veins and grains of mineral in shattered quartzite and highly altered porphyry. Unlike many of the disseminated deposits, much of the copper occurs native and as the oxide, though chalcocite ores are also abundant. To the present time the main production has come from shallow workings following high-grade streak of native copper oxide and chalcocite ores. The average recovery of copper from ores mined in the district in 1910 was 3.8 per cent.

Since 1909 the Chino Copper Co. has been actively developing the main mineralized area by means of churn drills, and the management reports, March 1, 1911, developed and partially developed ore to the amount of 45,238,312 tons, with an average copper content of 2.3 per cent.

The average thickness of the ore body is 107 feet and the average thickness of the barren capping is 82 feet. It is stated that over 71 per cent of the developed ore can be extracted by steam-shovel methods, and a part of the area has already been stripped for mining.

A concentrating plant with a daily capacity of 3,000 tons, which will be ready for operation late in 1911, is in process of construction at Hurley, about 9 miles from the mines. The concentrates will be shipped to El Paso for further treatment.

The district is served by a branch of the Santa Fe Railroad connecting with the main line and with the Southern Pacific at Deming.

Burro Mountain district.—The Burro Mountain district southwest of Silver City made but a small production in 1910. The total production from the district has probably been about 10,000,000 pounds of copper.

The Burro Mountain [2] consists of a pre-Cambrian complex that has been intruded by monzonite porphyry. The copper ores occur

[1] Lindgren, W., Graton, L. C., and Gordon, C. H., Ore deposits of New Mexico: Prof. Paper U. S. Geol. Survey No. 68, 1910, p. 305.
A report on the geology of the Silver City quadrangle is in preparation by the United States Geological Survey.

[2] Lindgren, W., Graton, L. C., and Gordon, C. H., Ore deposits of New Mexico: Prof. Paper U. S. Geol. Survey No. 68, 1910, p. 321.

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mainly as impregnations and replacements along irregular fractures and zones of crushing. The primary sulphide is cupriferous pyrite, but the workable deposits have resulted from the secondary enrichment of the primary ores.

Development by churn-drill and underground methods during the year considerably increased the ore reserves. The Burro Mountain property, controlled by Phelps, Dodge & Co., is held as an ore reserve and important production will probably not be made for some time.

The Lordsburg district was the only other important contributor to the copper output of the Territory.

TENNESSEE.

The production of blister copper from Tennessee in 1910 was 16,691,777 pounds, as compared with 19,207,747 pounds in 1909.

The decrease in production was due to the inability of the sulphuric-acid plants to handle the fumes from the smelters when operated at full capacity. The entire output was from the Ducktown district located in the extreme southeastern part of the State in Polk County. The district was one of the earliest large producers in the country. Operations began about 1850, and from that date till the close of the Civil War there was a large production from the "black-copper" ores. With the exhaustion of the rich secondary deposits attempts were made to work the lean original sulphides. These efforts met with only indifferent success, and in the late seventies the smelters shut down, thus ending the first period of activity in this district. The present period of activity began in 1890, when the Ducktown Sulphur, Copper & Iron Co. began operations. Since that time the district has been a steady producer from the primary sulphide ores. To the close of 1910 the total output of the district has been approximately 211,700,000 pounds.[1]

The ores[2] occur as steeply dipping lenses replacing calcareous bands in schist, the ore bodies in general conforming to the dip and strike of the schistosity of the inclosing rock. The principal sulphide is pyrrhotite, with subordinate pyrite, chalcopyrite, and sphalerite. Extensive gossans cap the ore bodies, and it was the enriched zones underlying these that furnished the rich chalcocite ores that were extracted during the first period of activity.

In 1910 the ores of the district yielded a little over 30.4 pounds of blister copper per ton, or 1.52 per cent, with an average of 0.66 cent gold and silver per pound of copper that was treated electrolytically. A part of the copper is marketed without electrolytic refining. The fact that the ores can be extracted without timbering, the cheap supply of coke and coal from Tennessee and West Virginia, and the comparatively low cost of labor have made it possible to mine and treat these low-grade ores at a profit.

The pyritic process of smelting is practiced successfully by both companies. The low-grade matte produced by the first smelting is resmelted and brought to a proper grade for conversion.

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[1] The production of the district has been compiled by Prof. W. H. Emmons and kindly furnished to the writer before publication.

[2] The deposits have been described by Henrich, Carl, Am. Inst. Min. Eng., vol. 25, p. 173; Weed, W. H., Am. Inst. Min. Eng., vol. 30, p. 452; Kemp, J. F., Am. Inst. Min. Eng., vol. 31, p. 224; Higgins, E., Eng. and Min. Jour., vol. 86, 1908, pp. 1237–1241; Channing, J. P., Min. and Sci. Press, vol. 96, 1908, p. 97; Gottsberger, B. B., Mining World, vol. 29, 1908, pp. 911–914; Weed, W. H., Ore deposits of the Appalachian States, Bull., U. S. Geol. Survey, No. 455, 1911, p. 152.

A detailed report on the district is in preparation by the United States Geological Survey.

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Sulphuric-acid plants were operated by both the Ducktown Sulphur, Copper & Iron Co. and the Tennessee Copper Co. The successful operation of these plants has apparently not only solved the troublesome smelter-smoke problem, but added very materially to the revenue of the companies. The sulphuric-acid production will probably be fully as important in the future as the copper output.

The Tennessee Copper Co., in 1910, treated 424,197 tons of ore from the district, yielding 12,429,009 pounds fine copper, a yield of 29.3 pounds per ton, or 1.465 per cent. The ore reserves of the company's mines at the close of the year amounted to 3,183,671 tons of available ore and 1,380,000 tons of probable ore, a total of 4,563,671 tons. During the year the furnaces were remodeled to adapt them to the acid plant. The sulphuric-acid plant was completed and should be capable of operating at full capacity for 1911.

The district is served by a branch line of the Louisville & Nashville Railroad, the mines and smelters of the companies being connected with this by private lines.

UTAH.

In 1910 Utah produced 125,185,455 pounds of blister copper, as compared with 101,241,114 pounds in 1909. The marked increase was due to the production from the Bingham district.

The first record of production of copper from Utah is for 1872. The State did not become an important copper producer, however, until late in the nineties, since which time the growth of the industry has been steady and rapid. The total recorded output from the State to the close of 1910 has been 658,774,460 pounds, 4.31 per cent of the output from the United States since 1845. In 1910 Utah produced 11.59 per cent of the output. In total output and in the production for 1910 it ranks fourth among the copper-producing States.

Three copper-smelting plants were operated in the State during 1910. The matte smelter of the Yampa Smelting Co. was operated until August, when it was shut down and the ores of the company were shipped to the Garfield smelter. The Garfield smelter was operated throughout the year. The new plant of the International Smelting & Refining Co. at International was completed and placed in operation July 25, 1910, but was not operated at full capacity up to the close of 1910.

Bingham district.—The Bingham or West Mountain district, Salt Lake County, made about 112,000,000 pounds of blister copper in 1910, as compared with about 86,000,000 pounds in 1909.

The presence of copper minerals has been known since the early days of mining in the district, but for many years operations were confined to the production of lead, silver, and gold. Not until 1896 did the mining of copper ore become of commercial importance. To the close of 1910 the district has produced approximately 465,000,000 pounds, or 3.04 per cent of the output of the country since 1845. For 1910 the district yielded 10.37 per cent of the total production. In total output the district ranks sixth among those of the country and in the production for 1910 it ranks fourth.

The ore deposits of the district [1] are closely associated with masses of monzonite intruded into a series of quartzites with intercalated

[1] For detailed information see Boutwell, J. M., Economic geology of the Bingham mining district, Utah: Prof. Paper U. S. Geol. Survey No. 38, 1905.

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beds of limestone and shale of Carboniferous age. The ores are of two types of occurrence—as irregular replacement deposits in limestone near the monzonite contact, and as disseminated deposits through altered porphyry.

Prior to 1907 most of the copper from the district was derived from the contact deposits in limestone. These are massive bodies of pyrite carrying chalcopyrite in varying amounts. Secondary enrichment has not been of great importance in this type of deposit. The ores vary greatly in copper content and consequently the average percentage derived for a given year depends largely on the grade that can be worked at a profit at the price of copper. In 1910 the ores yielded about 2.28 per cent copper and $2.50 in gold and silver per ton of ore. About 475,000 tons of this type of ore was produced during the year, yielding nearly 22,000,000 pounds of copper.

The primary mineralization of the disseminated type consists of grains of pyrite and chalcopyrite disseminated through the highly altered porphyry. The commercial ore is the result of secondary enrichment, the copper content near the surface being partially leached and redeposited as coatings of chalcocite and occasionally as bornite and covellite on the sulphides lower down. The commercial ore forms a blanket-like deposit covered by the leached capping and underlain by the lean primary mineralization. The average thickness of the commercial ore is stated to be 345 feet. The thickness of the capping varies greatly at different points. On the original Utah copper ground it is stated to be 80 feet, while the average for the original Boston Consolidated ground is estimated to be 160 feet. The average thickness of capping over all the ore of the Utah Copper Co. is estimated at 105 feet. The secondary enrichment in the Bingham disseminated ores is less than in several of the other disseminated deposits. The ores are extracted by both steam shovel and underground methods. During the year more than 4,700,000 tons of disseminated ore was mined, yielding about 1 per cent copper and about 21 cents in gold and silver per ton.

The ores were treated at the mills at Garfield, at the Copperton mill at Bingham until August, and at the Ohio Copper Co.'s mill. The ores and concentrates from the district were reduced at the Garfield smelter, the Yampa smelter, and the International smelter.

During the year the Utah Copper Co. increased the capacity of its Magma mill to 10,000 tons of ore per day. The Arthur mill was in process of reconstruction after the design of the Magma and when completed will have a capacity of 8,000 tons daily. The Copperton plant was closed. The mills of the company treated 4,340,245 tons of ore, with an average copper content of 1.54 per cent. The average extraction was 66.55 per cent, equivalent to 20.51 pounds of copper per ton of ore treated. The total production for the year by the Utah Copper Co. was 89,019,511 pounds. The average cost of producing this copper was 8.069 cents per pound. The company reported at the close of the year 152,130,000 tons of fully developed ore. 60,000,000 tons averaging 2 per cent copper, and 92,130,000 tons averaging 1.6 per cent copper. Partly developed ore with an average copper content of 1.4 per cent brings the total tonnage to 203,500,000 tons with an average copper content of 1.67 per cent.

Operations were conducted by the Ohio Copper Co. throughout the year, though the mill is not yet fully equipped.

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The Utah Consolidated Mining Co. shipped 179,224 tons of copper ore, averaging 2.458 per cent copper and 0.0843 ounce of gold and 0.9627 ounce of silver per ton. At the close of the year there was reported as in sight in the mine 381,000 tons of ore averaging 2.44 per cent copper and 0.05 ounce of gold and 0.63 ounce of silver per ton. During the latter part of the year the ores were shipped over the new aerial tram to the International smelter.

After the close of the Yampa smelter the ores of that company were shipped to the Garfield smelter for treatment. Several other companies in the district were important producers of copper and copper-lead ores.

The district is served by a branch of the Denver & Rio Grande Railroad, and the Utah Copper Co. is constructing a railroad connecting its mines at Bingham with the mills at Garfield. Cable tramways are employed to considerable extent; the ores from the Utah Consolidated mines are delivered to the International smelter in this manner, and ores from other mines are delivered to the railroad over cable tramways.

Tintic district.—The Tintic district in Juab County made a production of 9,000,000 pounds of blister copper in 1910, as compared with about 6,000,000 pounds in 1909. The production of copper from the Tintic district is largely incidental to the production of other metals. The amount of ore in which copper is the most important metal constituent is relatively small. There has been a small output of copper from the district for many years, but no accurate statistics of the early output are available. Tower and Smith have made an estimate of the production to 1897, and by adding to this the production since that time, compiled from the best sources available, it is estimated that to the close of 1910 the district has yielded approximately 80,000,000 pounds of copper.

The occurrence of the ores [1] may be briefly summarized as follows: The sedimentary series, consisting of limestone and quartzite, has been intruded by an extensive mass of monzonite. The ores occur as replacement deposits in the limestone near the monzonite contact, as replacement veins in the igneous rocks, and as replacement veins in the sedimentary series.

The most valuable deposits developed are of the last-named type. The fissures are usually nearly vertical, and the replacement bodies are extremely irregular in form and variable in size. The original minerals were pyrite, galena, sphalerite, and enargite, with rich silver and gold minerals in a gangue of quartz and barite.

There has been little development below the water level, which is usually below 1,600 feet in the deposits in limestone, and oxidation to this point has been very complete. Recent developments below the water level in some of the mines have been encouraging, revealing sulphide ores of high grade.

The Centennial-Eureka mine was the most important producer of copper in 1910 as in previous years.

Frisco district.—The Frisco district of Beaver County made a production of about 1,100,000 pounds of copper in 1910, as compared with about 1,200,000 pounds in 1909.

[1] For detailed report, see Tower and Smith, Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1899, pp. 601-767.

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The first important production of copper from the district was from the Horn Silver mine in 1889, and since that time there has been a production of copper from lead-silver ores and from small copper mines. The importance of the district as a copper camp dates from the starting of the mill in 1905 to treat the ores of the Cactus mine. To the close of 1910 the district has yielded approximately 29,000,000 pounds of copper.

At the present time the Cactus mine of the South Utah Mines and Smelters Co. is the only important producer of copper ores.

The ores,[1] which consist of pyrite and chalcopyrite, occur disseminated in a highly brecciated and altered area of quartz monzonite. Most of the ore is low grade and requires concentration before shipping. The mill was shut down early in 1909 and operations were not resumed until October, 1910. During the interval the mill was remodeled and is said to be capable of handling in excess of 1,000 tons daily.

Lucin district.—During the last few years this district has been a considerable producer of copper.

The ores are reported to occur as replacement of limestone associated with an intrusive rock.

In addition to the districts mentioned, several lead-silver camps contributed to the copper output of the State.

OTHER STATES.

New Hampshire.—New Hampshire made a production of 12,409 pounds of blister copper in 1910, as compared with 88,744 pounds in 1909. The output was from the Milan mine, Coos County. The ores,[2] which consist mainly of pyrite, chalcopyrite, and zinc blende with minor amounts of other sulphides, occur as lenses in schist. Much of the ore is treated for acid manufacture, and the copper is recovered from the resulting "cinders."

North Carolina.—North Carolina produced 181,263 pounds of blister copper in 1910, as compared with 120,451 pounds in 1909. The output was principally from the Virgilina district in Granville and Person counties. The deposits[3] occur as fissure veins in schist that has been invaded by granitic intrusives, and the ore veins are thought to be closely related to this intrusive. The ore minerals are bornite and chalcocite in a gangue of quartz with subordinate carbonate and epidote. The chalcocite of this deposit is thought to be in part a primary mineral.

The Gold Hill district has in recent years produced some copper, though there was little activity in the district in 1910. The deposits[4] consist of rather narrow stringers or veins of auriferous pyrite and chalcopyrite in a quartz gangue in schist.

In the latter part of 1909 some ores were produced from the Cullowhee mine, Jackson County. The output is included in the 1910 production of blister copper.

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[1] Emmons, S. F., The Cactus copper mine, Utah: Bull. U. S. Geol. Survey No. 260, 1905, p. 242.

[2] Emmons, W. H., Some ore deposits of Maine and the Milan mine, New Hampshire: Bull. U. S. Geol. Survey No. 432, 1910, p. 54.
Weed, W. H., Copper deposits of the Appalachian States: Bull. U. S. Geol. Survey No. 455, 1911, p. 18.

[3] Laney, F. B., The relation of bornite and chalcocite in the copper ores of the Virgilina district of North Carolina and Virginia: Proc. U. S. Nat. Mus., vol. 40, pp. 513–524.
Weed, W. H., op. cit., p. 67.

[4] Laney, F. B., The Gold Hill mining district: Bull. North Carolina Geol. and Econ. Survey No. 21, 1910, p. 83.
Weed, W. H., op. cit., p. 140.

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The deposits[1] occur as poorly defined veins in schist. The principal ore minerals are pyrrhotite and chalcopyrite.

Oregon.—Oregon produced 22,022 pounds of blister copper in 1910, as compared with 245,403 pounds in 1909. To the close of 1910 the State has a recorded output of 2,449,784 pounds of copper. The largest production in recent years has been from the Waldo district in Grant County. The smelting plant at Takilma was idle in 1910, which accounts for the decrease in production for the State.

Pennsylvania.—The blister copper production from Pennsylvania in 1910 was 740,626 pounds, as compared with 994,089 pounds in 1909. The output was from the iron mines of Lebanon County. These ores[2] carry a small amount of pyrite and chalcopyrite, which is separated by magnetic dressing of the iron ores. The sulphides are treated for their copper values.

South Dakota.—The smelter of the Continental Copper Mining & Smelting Co., of Hill City, was idle during 1910, and the State had practically no production of copper.

Vermont.—Vermont made a production of 1,935 pounds of blister copper in 1910. The most important deposits of the State are those near Ely. These deposits have been worked at intervals since 1821 and have made a considerable contribution to the copper output of the country, though the production in the early years is not known.

The ores[3] consist of irregular lenses of pyrite, pyrrhotite, and chalcopyrite in schistose rocks that have resulted from the metamorphism of sediments.

Virginia.—Virginia produced 105,313 pounds of blister copper in 1910, as compared with 231,971 pounds in 1909.

The principal production from Virginia was from the Virgilina district and from the Dumfries district, Prince William County. The occurrence of the ores in the Virgilina district has already been mentioned under North Carolina. At Dumfries the main output is from pyritic ores carrying low values in copper. These ores are treated for the production of sulphuric acid and the resultant "cinder" is smelted for its copper content. Some copper ore is sorted in the mining of the pyrite ore. The smelter at Dumfries was not operated in 1910.

The ores consist of lenses of pyrite with a little chalcopyrite in schist.

Other districts have been productive but were not operated in 1910. The most important of these is the "great gossan lead" extending from Carroll County into North Carolina from which an important production was made from the enriched "black copper" zone underlying the gossan.

The ores[4] consist of pyrrhotite with some pyrite in schist.

Washington.—Washington made a production of 65,021 pounds of blister copper in 1910, as compared with 120,611 pounds in 1909. The State contains no important producing district, the total recorded output to the close of 1910 being but 1,977,781 pounds.

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[1] Weed, W. H., op. cit., p. 138.
[2] Spencer, A. C. Magnetite deposits of Cornwall type, Pennsylvania: Bull, U. S. Geol. Survey No. 315, 1907, pp. 185–189.
Weed, W. H., op. cit., p. 62.
[3] Smyth, H. L., and Smith, P. S., The copper deposits of Orange County, Vt.: Eng. and Min. Jour., vol. 77, 1904, p. 177.
Weed, W. H., op. cit., p. 24.
[4] Weed, W. H., op. cit., p. 116.

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The Northport smelter was not operated during the year. The Tacoma smelter was operated principally on ores from outside the State.

Wyoming.—Wyoming made a production of 217,127 pounds of blister copper in 1910, as compared with 433,672 pounds in 1909.

To the close of 1910 the State has a recorded output of 25,843,400 pounds.

The Encampment district, the most important producer, was not active in 1910, as the principal company, the United Smelters, Railway & Copper Co., successors to the Penn-Wyoming Copper Co., was in litigation.

Exact statistics of the output of this district are not available, but it has probably been in excess of 20,000,000 pounds.

The most important deposits of the Encampment district [1] occur in a zone of brecciated quartzite underlying schist. The original ore was chalcopyrite with possibly some pyrite. Secondary enrichment has produced important bodies of chalcocite in the upper workings, but these give place to chalcopyrite at depth.

REFINERY PRODUCTION.

The refinery output of the United States was made by 12 plants, 8 of which employ the electrolytic method and 5 employ the furnace process on Lake Superior copper, the Buffalo plant employing both the electrolytic and the furnace refining method. Six of the large electrolytic refineries are located on the Atlantic tidewater, 5 Lake refineries are on the Great Lakes, 4 in Michigan and 1 in New York; the only plant west of the Great Lakes is at Great Falls, Mont. In addition to these refineries, there are numerous plants in different parts of the country that make a considerable output from old copper, brass, and other alloys of copper.

The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

CASTING COPPER.

Blister copper that is low in precious metals and sufficiently free from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for the uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries such low values in precious metals that, together with the value added to the copper by electrolytic refining, these values will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is comparatively small. Some blister copper low in precious metals is exported without further treatment and is probably consumed without electrolytic refining. In the following table this is included with casting copper. A large percentage of the casting copper, shown in the table, is from the Morenci-Metcalf district, Arizona, and from the Ducktown district, Tennessee. Both districts produce a

[1] Spencer, A. C., Copper deposits of the Encampment district, Wyoming: Prof. Paper U. S. Geol. Survey No. 25, 1904.

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rather high grade of blister carrying low values in precious metals, and it is found profitable to market much of it without electrolytic refining. During 1910 the production of new casting copper amounted to 72,271,426 pounds, 68,260,688 pounds being of domestic origin and 4,010,738 pounds of foreign origin.

LAKE COPPER.

By Lake copper as used in this report is meant the output of the Lake smelters. Considerable of this output is refined electrolytically, but most of the electrolytically refined Lake copper is mixed with furnace-refined copper or sold as some brand of Lake copper. Of the 221,462,984 pounds of copper produced by the Lake smelters, about 35,600,000 pounds were refined electrolyticlly, either to free it from impurities or to recover the silver content.

ELECTROLYTIC COPPER.

Under electrolytic copper, as shown in the following table, is included all new copper that was refined electrolytically, except that from the Lake district. In 1910 the production of electrolytic copper from primary materials of domestic origin amounted to 782,171,204 pounds, and that of foreign origin to 346,133,521 pounds. Electrolytic copper to the amount of 9,952,358 pounds was produced from secondary sources, making a total electrolytic production of 1,138,257,083 pounds for the year.

SECONDARY COPPER.

Under secondary copper is considered material recovered from remelting old copper, copper scraps, etc., and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. One hundred and forty-nine plants reported to the United States Geological Survey as making a production from secondary sources. Though a systematic canvass of secondary plants was made for 1910, it is probable that the amount of secondary copper recovered slightly exceeds that reported.

For 1910 there was reported as recovered from the remelting of old copper, copper clippings, etc., 89,000,000 pounds; recovered from alloys other than brass, 13,000,000 pounds; and from the remelting of old brass and brass clippings, assuming this to contain an average of 70 per cent copper, there was recovered 87,000,000 pounds. The total recovery of copper reported from secondary sources is, therefore, about 189,000,000 pounds. Of this amount, about 31,000,000 pounds was recovered by the regular refining companies, and the remainder, about 158,000,000 pounds, was recovered by plants treating only secondary material. Of this production, as nearly as can be ascertained, at least 60,000,000 pounds was recovered from clean scrap produced in the manufacture of copper and brass articles, leaving approximately 129,000,000 pounds recovered from material that had entered the trade in manufactured form.

As contrasted with lead and zinc, the uses for which copper is principally employed are such that a large percentage of the metal can be eventually recovered and returned to the trade. The period

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elapsing between the time when copper enters the trade and is returned as scrap varies, of course, greatly with the uses for which it is employed, and no data are available that will give even an approximation of this period. However long this period may be, it is evident that there will be an increase in the production of copper from secondary sources proportionate to the great increase in the consumption of copper. The production from old scrap in 1910 was equal to between 17 and 18 per cent of the domestic consumption of new copper, as compared with between 12 and 13 per cent for 1909. A part of this gain may be attributed to the more complete statistics for 1910, but it is also evident that there has been an actual increase. This factor of the copper industry is one that must command increasing attention in the future.

TOTAL REFINED COPPER.

The total production of new refined copper in 1910 was 1,422,039,133 pounds. This was the largest output in the history of the industry, exceeding that of 1909 by 31,017,679 pounds.

The production of electrolytic, Lake, and casting copper from primary sources and the production of secondary copper by the regular refining plants in 1909 and 1910 is shown in the following table:

Production of primary and secondary copper by the regular refining plants in 1909 and 1910.

	1909		1910	
	Domestic.	Foreign.	Domestic.	Foreign.
Electrolytic	778,808,910	323,085,954	782,171,204	346,133,521
Lake	227,006,923	.....	221,462,984	.....
Casting	59,750,068	2,370,579	68,260,688	4,010,738
	1,065,564,921	325,456,533	1,071,894,876	350,144,259
Total primary	1,391,021,454		1,422,039,135	
Secondary	14,598,065		31,040,874	
Total output	1,405,619,519		1,453,080,009	

The figures for Lake copper include the Michigan copper that was treated electrolytically, and casting copper includes blister copper that was marketed without refining.

In addition to the secondary material treated by the regular refining companies, plants that treated secondary material exclusively produced a total of 158,000,000 pounds of copper as copper and in brass and other alloys of copper, making a total production of 189,000,000 pounds from secondary sources. Of this total, approximately 60,000,000 pounds was produecd by remelting clean scrap produced in the process of manufacture of copper and brass articles.

If the output of plants treating purely secondary material is added to the production of the regular refining companies, the contribution of the United States to the world's supply of copper for 1910 is found to be 1,611,000,000 pounds.

During 1910 reports were made by the Copper Producers' Association of the monthly output of marketable copper by the regular

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refining plants in the United States. The following table shows the the output by months and the total for the year:

Monthly output of marketable copper in 1910, as reported by the Copper Producers' Association, in pounds.

Month.	Output.	Month.	Output.
January	116,547,287	August	127,803,618
February	112,712,493	September	119,519,983
March	120,067,467	October	126,469,284
April	117,477,639	November	119,353,463
May	123,242,476	December	123,339,219
June	127,219,188		
July	118,370,003	Total	1,452,122,120

COPPER SULPHATE.

The production of copper sulphate or bluestone by the refineries of the United States in 1910 was 29,728,143 pounds, having a copper content of about 7,521,000 pounds, as compared with about 30,980,729 pounds, having a copper content of about 7,838,123 pounds, in 1909.

STOCKS.

Returns from all smelting and refining companies show that the following stocks of electrolytic, Lake, and casting copper were on hand at the beginning and the end of the year 1910:

Stocks of refined copper, in pounds.

January 1, 1910	141,486,244
January 1, 1911	122,803,656
Decrease during 1910	18,682,588

In addition to the stocks of refined copper, there were at smelters, in transit to the refineries, and at the refineries, blister copper and material in process of refining to the amount of 245,218,530 pounds January 1, 1911, as compared with 266,754,808 pounds January 1, 1910.

During 1910 the Copper Producers' Association reported the stock of the marketable copper held at all points in the United States on the first of each month. The following table shows the stocks held at the close of each month:

Stocks of marketable copper of all kinds on hand at all points in the United States on the first day of each month for 1910 and on Jan. 1, 1911, as reported by the Copper Producers' Association, in pounds.

Month.	Quantity.	Month.	Quantity.
January	141,766,111	August	170,640,678
February	98,463,339	September	168,881,245
March	107,187,992	October	148,793,714
April	123,824,874	November	139,261,914
May	141,984,159	December	130,389,069
June	160,425,973	January 1, 1911	122,030,195
July	168,386,017		

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IMPORTS AND EXPORTS.

IMPORTS.

The quantity of copper in unmanufactured form imported into the United States in 1910 was 344,435,771 pounds, according to the records of the Bureau of Statistics of the Department of Commerce and Labor. The imports in 1909 were 321,801,114 pounds. The following table shows the character and source of copper-bearing materials imported during 1909 and 1910:

Imports of copper into the United States in 1909 and 1910, by countries, in pounds.

Countries.	Ore, matte, and regulus.		Pigs, bars, ingots, plates old, etc.	
	1909	1910	1909	1910
United Kingdom			26,527,574	18,649,727
Germany	6,362,283	961,534		
Spain	5,151,910	4,927,830	17,089,614	25,411,393
Canada	9,689,829	10,034,806	29,196,351	29,016,785
Mexico	23,914,040	22,731,184	76,119,724	84,008,907
Chile	18,580,601	19,425,233	5,330,633	4,289,079
Cuba	9,836,258	8,858,373		
Peru			32,344,009	40,759,887
Japan			23,830,140	18,482,989
Australia and Tasmania			17,378,819	22,913,387
Other countries	7,552,472	18,286,015	12,896,857	15,728,642
Total	81,087,393	85,224,975	240,713,721	259,210,796
Grand total			321,801,114	344,435,771

In 1910 ore to the amount of 420,220 tons, with a copper content of 64,203,789 pounds, and 33,527 tons of matte and regulus, with a copper content of 21,021,186 pounds, were imported. Of the copper imported as matte and blister about 9,700,000 pounds were derived from copper ores or matte that had been exported and treated in foreign smelters, leaving about 334,700,000 pounds derived from foreign materials. According to the report of the smelters and refiners, 350,144,259 pounds of new copper was produced in this country from foreign material, a difference of 15,444,254 pounds between the amount reported by the smelters and refiners as treated and that reported by the Bureau of Statistics as imported.

EXPORTS.

The exports of metallic copper from the United States in 1910 amounted to 708,316,543 pounds, according to the Bureau of Statistics. This is the largest export made in any year, exceeding that of 1909 (682,846,726 pounds) by 25,469,817 pounds. In addition to the exports of metallic copper, the copper content of 43,784 long tons of ore, matte, and regulus was exported in 1910, as compared with the content of 59,880 long tons in 1909.

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Exports of domestic copper from the United States in 1909 and 1910, by countries.

Countries.	Ingots, bars, plates, and old (pounds).	
	1909	1910
United Kingdom	156,511,113	98,090,213
Belgium	6,016,861	7,176,258
France	99,003,962	116,193,850
Germany	138,213,290	175,861,028
Italy	26,386,069	34,110,237
Netherlands	204,378,211	221,764,806
Russia in Europe	3,519,216	6,848,311
Other Europe	41,661,979	42,203,861
Canada	6,790,410	5,628,487
Other countries	365,615	499,492
Total	682,846,726	708,316,543

The report of the Copper Producers' Association, which is based on a slightly different period, shows a delivery of 722,431,494 pounds for export.

CONSUMPTION.

The apparent consumption of refined new copper in the United States in 1910 was about 732,400,000 pounds; in 1909 it was about 688,500,000 pounds.

The method employed in determining the quantity of copper retained for domestic consumption is shown in the following table. It does not take into consideration stocks of copper held by consumers.

Domestic consumption of refined new copper in 1909 and 1910, in pounds.

	1909	1910
Total refinery output	1,391,021,454	1,422,039,135
Stock at beginning of year	121,876,759	141,486,244
Total available supply	1,512,898,213	1,563,525,379
Refined copper exported	682,846,726	a 708,316,543
Stock at end of year	141,486,244	122,803,556
Total withdrawn from supply	824,332,970	831,120,199
Apparent consumption	688,565,243	732,405,180

a Exports of pigs, bars, ingots, plates, etc., reported by the Bureau of Statistics. The change in this sum from that published in the advance statement, May 29, 1911, is due to a change in the figures of exports as reported by the Bureau of Statistics.

If to the 732,400,000 pounds of new refined copper is added the 189,000,000 pounds of secondary copper and copper in alloys produced during the year, it is found that a total of 921,400,000 pounds of new and old copper was available for domestic consumption.

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The following table shows the monthly deliveries of copper for domestic consumption and export as reported by the Copper Producers' Association:

Monthly deliveries of copper for domestic consumption and for export, in 1910, as reported by the Copper Producers' Association, in pounds.

Month.	Domestic consumption.	Export.	Total.
January	78,158,387	81,691,672	159,850,059
February	66,618,322	37,369,518	103,987,840
March	62,844,818	40,585,767	103,430,585
April	67,985,951	31,332,403	99,318,354
May	59,305,222	45,495,440	104,800,662
June	53,363,196	65,895,948	119,259,144
July	56,708,175	59,407,167	116,115,342
August	67,731,271	61,831,780	129,563,051
September	64,501,018	75,106,496	139,607,514
October	67,814,172	68,186,912	136,001,084
November	60,801,992	67,424,316	128,226,308
December	43,594,018	88,104,075	131,698,093
Total	749,426,542	722,431,494	1,471,858,036

It may be noted that the difference in domestic deliveries as shown by the reports of the Copper Producers' Association and those calculated above is due to the fact that the figures of export as reported by the Bureau of Statistics and by the Producers' Association do not agree exactly. The cause of this difference is stated under the discussion of exports.

USES.

No systematic attempt has been made to ascertain the proportion of the copper output of 1910 used in different industries, as electric transmission, brass manufacture, casting, etc. Some idea of the quantities entering the different industries can be gained from the forms in which the output of the refineries was cast. The following table shows the approximate quantity of copper cast in the different forms during 1910 as reported by the refining companies. It will be noted that the total does not equal the refinery output of copper for 1910.

Forms in which copper was cast in 1910, in pounds.

Form.	Total.	Percentage.
Wire bars	720,505,724	50
Ingots and ingot bars	441,302,990	31
Cakes	142,660,100	10
Cathodes	99,500,146	7
Other forms	26,620,036	2
Total	1,430,588,996	100

It may be assumed that a large portion of the 50 per cent cast as wire bars was used for electrical purposes and that the 10 per cent cast as cakes was used largely for rolling. The other forms are less easily classified. The 7 per cent cast as cathodes, together with a portion of the ingots, probably entered the brass industry, and a

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large quantity of copper ingots was used in casting. The refinery output for 1909 was cast as follows: Wire bars, 46 per cent; ingots, 25 per cent; cakes, 10 per cent; cathodes, 16 per cent; other forms, 3 per cent.

PRICES.

The average yearly quoted price of electrolytic copper at New York in 1910 was 12.738 cents per pound; in 1909 the price was 12.98 cents per pound. The average monthly prices for electrolytic copper in 1909 and 1910 are given in the following table:

Monthly prices per pound of copper in 1909 and 1910, in cents.

Month.	Price of electrolytic copper, in cents.	
	1909	1910
January	13.893	13.620
February	12.949	13.332
March	12.387	13.255
April	12.562	12.733
May	12.893	12.550
June	13.214	12.404
July	12.880	12.215
August	13.007	12.490
September	12.870	12.379
October	12.700	12.553
November	13.125	12.742
December	13.298	12.581
Average	12.982	12.738

The average yearly price of Lake copper was 13.039 cents. These quoted prices are the basis on which much of the copper is sold by the mines and are used by the United States Geological Survey in calculating the value of both mine and smelter output. It is well known, however, that this average yearly price only approximates the actual average price received for copper sold during the year.

The actual average price received by Michigan companies was 12.993 cents per pound, and such data as are available indicate that the average price received for electrolytic copper was slightly higher than that given in the table.

WORLD'S PRODUCTION.

The smelter production of copper in the world was 1,903,297,003 pounds in 1910, as compared with 1,873,404,407 pounds in 1909. In 1910 the smelter output of the United States was 56.75 per cent of the world's production, as compared with 58.22 per cent in 1909 and with 56.54 per cent in 1908.

The following table shows the world's production, by countries. The figures are those compiled by Henry R. Merton & Co. (Ltd.), of London, reduced to pounds, except that the official figures for the production of the United States and Canada are inserted.

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World's production (smelter output) of copper in 1909 and 1910, in pounds.

Countries.	1909	1910
Germany	50,264,880	55,335,460
England	881,840	1,102,300
Italy	6,172,880	7,275,180
Norway	20,502,780	23,368,760
Austria	3,527,360	4,850,120
Russia	39,682,800	50,044,420
Sweden	4,409,200	4,402,200
Spain and Portugal	116,843,800	112,655,060
Turkey	1,763,680	1,322,760
Hungary	10,361,620	11,023,000
Total Europe	254,410,840	271,386,260
Canada	52,493,863	56,598,074
Mexico	126,103,120	131,614,620
Newfoundland	3,086,440	2,425,060
United States	1,092,951,624	1,080,159,509
Total North America	1,274,635,047	1,270,797,263
Argentina	1,322,760	661,380
Bolivia	4,409,200	5,511,500
Chile	80,247,440	78,924,680
Peru	35,934,980	41,005,560
Cuba	6,613,800	7,716,100
Total Central and South America	128,528,180	133,819,220
Cape Colony	10,361,620	9,920,700
Namaqualand	5,070,580	5,511,500
Other Africa	17,857,260	18,518,640
	33,289,460	33,950,840
Japan	105,379,880	102,954,820
Australia	77,161,000	90,388,600
Grand total	1,873,404,407	1,903,297,003

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LEAD.

By C. E. SIEBENTHAL.

INTRODUCTION.

An estimate of the production of refined lead in 1910 was given out in the form of a press bulletin on January 2, 1911. This was based on reports from every smelter, giving the actual production for the first 10 or 11 months, with estimates for the remainder of the year. The total thus obtained was one-seventh of 1 per cent, or 698 tons, less than the final figures of production. The complete figures of production and consumption of primary [1] refined lead and of imports and exports of lead in ore and bullion were given in the advance statement of lead production, which was published April 10, 1911. The present report contains, in addition, tables and curves showing the production, consumption, imports, exports, and prices for a period of years, a comparison of the mine and the smelter production of lead by States, a list of lead smelters, and a résumé of metallurgical advance in 1910.

The statistics of production of lead in this country in 1910 have been compiled by the United States Geological Survey from confidential reports by each lead-smelting company in operation during the year. The statistics of the recovery of secondary lead were also collected by the United States Geological Survey. The statistics of domestic consumption are taken in part from the smelter returns and in part from the records of the Bureau of Statistics of the Department of Commerce and Labor, and the tables for foreign production and consumption were compiled from the sources indicated.

STATE OF LEAD INDUSTRY IN 1910.

The lead-smelting industry in 1910 had on the whole a busy year. The total production of primary lead from all sources, domestic and foreign, made a gain of 5 per cent over that of 1909, and in this gain, in contrast to the preceding year, domestic lead played its proportionate part. In fact, Missouri made individually a larger gain than the whole domestic increase and produced over 43 per cent of the domestic output of lead. The soft-lead production of the United

[1] By primary lead is meant lead which has been produced directly from ore. This term is used for purposes of distinction from secondary lead, which is obtained by refining skimmings, drosses, old metals, etc., figures for the production of which are given on a later page. Wherever in this report the word "lead" is used without qualification primary lead is to be understood.

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States is now nearly equal to the argentiferous-lead production, and from the present outlook bids fair in the next few years to excel it considerably.

As has been true for several years, certain important producers were unwilling to report stocks of lead on hand at the close of the year, so that it is not possible to state accurately the deliveries to consumption. As the next best thing, the lead available for consumption is calculated from the domestic production, together with imports, exports, and stocks of foreign lead in bonded warehouse. Judged on this basis, there can hardly have been any considerable increase in stocks of domestic lead, and it seems more likely, comparing the apparent production for the last four years, that there was a reduction in such stocks. On the other hand, the foreign lead in bonded warehouse was just doubled during the year, increasing from 17,405 short tons to 35,972 short tons.

PRODUCTION.

PRODUCTION, 1825–1910.

The production of lead in the United States since 1825 from domestic ores and from foreign ores and base bullion is shown in the table following. For the early years, in the absence of official records, the figures have been compiled from the best available sources. The figures for the period from 1825 to 1853 are those published by Whitney; those for the later years were collected by E. A. Caswell. Totals for 1882 were compiled from statistics gathered by the Census Bureau. Since 1882 the figures have been annually collected by the United States Geological Survey.

According to Hahn,[1] argentiferous-lead ore was smelted in Montana and Nevada as early as 1866–67, but for the silver only, as the value of the lead would not pay transportation charges to market. With the completion of the Union Pacific Railroad in 1869 and the development of the mines at Eureka, Nev., the production of lead bullion began. The first figures of this production which are available are for 1873. It is evident from the totals for 1871 and 1872 that not much bullion was produced before 1873. Estimates have been made for these years, as well as for 1874, in order to arrive at totals for the different classes of lead. Foreign bullion, principally from Mexico, began in 1891 to be imported into this country for refining, but before 1906 the annual quantities so imported were not distinguished in the statistical record of general imports from the lead imported in ore. Since the soft lead is all domestic, the desilverized lead of domestic origin can be readily found by subtracting the total lead of foreign origin from the total desilverized-lead production of that year, or by subtracting the soft lead from the total domestic lead of that year. Prior to 1906 the total production of antimonial lead is included in the production of refined, desilverized lead, but since that date it has been excluded.

[1] Mineral Resources U. S. for 1882, U. S. Geol. Survey, 1883, p. 324.

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Production of refined lead in the United States, 1825–1910, in short tons.

Year.	Antimonial lead.[a]	Desilverized lead.[b]	Soft lead.	Total production.[b]	From domestic ores and base bullion.	From foreign ores.[c]	From foreign base bullion.[d]
1825–1868	.....	.....	676,200	676,200	676,200	.....	.....
1869	.....	.....	17,500	17,500	17,500	.....	.....
1870	.....	.....	17,830	17,830	17,830	.....	.....
1871	.....	[e] 1,000	[e] 19,000	20,000	20,000	.....	.....
1872	.....	[e] 5,380	[e] 20,500	25,880	25,880	.....	.....
1873	.....	20,159	22,381	42,540	42,540	.....	.....
1874	.....	[e] 28,524	[e] 23,556	52,080	52,080	.....	.....
1875	.....	34,909	24,731	59,640	59,640	.....	.....
1876	.....	37,649	26,421	64,070	64,070	.....	.....
1877	.....	50,748	31,152	81,900	81,900	.....	.....
1878	.....	64,290	26,770	91,060	91,060	.....	.....
1879	.....	64,650	28,130	92,780	92,780	.....	.....
1880	.....	70,135	27,690	97,825	97,825	.....	.....
1881	.....	86,315	30,770	117,085	117,085	.....	.....
1882	.....	103,875	29,015	132,890	132,890	.....	.....
1883	.....	122,157	21,800	143,957	143,957	.....	.....
1884	.....	119,965	19,932	139,897	139,897	.....	.....
1885	.....	107,437	21,975	129,412	129,412	.....	.....
1886	.....	114,829	20,800	135,629	130,629	5,000	.....
1887	.....	136,552	25,148	160,700	145,700	15,000	.....
1888	.....	151,465	29,090	180,555	151,919	28,636	.....
1889	.....	153,709	29,258	182,967	156,397	26,570	.....
1890	.....	130,403	31,351	161,754	143,630	18,124	.....
1891	[a] 4,043	171,009	31,397	202,406	178,554	23,852	.....
1892	[a] 5,039	181,584	31,678	213,262	173,305	39,957	.....
1893	[a] 5,013	196,820	32,513	229,333	163,982	65,351	.....
1894	.....	181,404	37,686	219,090	159,351	59,739	.....
1895	.....	201,992	39,890	241,882	165,709	76,173	.....
1896	[a] 7,507	221,457	43,537	264,994	187,256	77,738	.....
1897	[a] 8,867	247,483	43,553	291,036	207,365	83,671	.....
1898	[a] 8,473	267,842	42,779	310,621	210,676	99,945	.....
1899	[a] 6,345	263,826	40,566	304,392	208,466	95,926	.....
1900	[a] 9,906	329,658	48,021	377,679	270,824	106,855	.....
1901	[a] 10,656	323,790	57,898	381,688	269,266	112,422	.....
1902	[a] 9,169	303,011	74,050	377,061	276,455	100,606	.....
1903	[a] 9,579	295,074	83,444	378,518	290,194	88,324	.....
1904	[a] 11,001	317,498	86,955	404,453	308,603	95,850	.....
1905	[a] 10,995	313,847	85,455	399,302	318,509	80,793	.....
1906	10,546	313,886	90,860	404,746	336,200	28,803	39,743
1907	9,910	314,241	99,948	414,189	337,340	43,925	32,924
1908	13,629	295,420	101,013	396,433	298,672	40,272	57,489
1909	12,896	320,310	118,802	448,112	345,255	74,035	28,822
1910	14,069	329,062	141,318	470,380	361,827	76,905	31,648
Total	.....	7,001,365	2,552,363	9,553,728	7,798,630	1,755,098	

[a] Included also under desilverized lead and total production prior to 1906.
[b] Including also antimonial lead, except for 1906–1910, inclusive.
[c] Including also lead from foreign base bullion for 1891–1905, inclusive.
[d] Included in lead from foreign ore prior to 1906.
[e] Estimated.

PRODUCTION CURVES.

The curves in figure 1 show graphically the total domestic lead production from 1830 to the present, the production of soft lead from 1830 to the present, and the production of desilverized lead since the beginning of that industry. In order to obtain a curve for the total production of soft lead, both plain and desilverized, the quantities of soft lead annually desilverized have been added to the output of the soft-lead smelters. Since there is no record of the desilverized soft lead prior to 1894, a portion of the curve representing the total production of soft lead is hypothetical, as indicated by a broken line. The curve representing the production of desilverized lead was obtained by taking the difference between the plain soft-lead curve and the curve of total lead production.

Perhaps the most striking fact brought out by the curve is that practically all the gain in domestic lead output in the last six years

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has been made in the production of soft lead. This is the graphic representation of the fact brought out by the production tables that the western lead-producing States have remained practically stationary in output in recent years, while the southeast Missouri lead region has made great gains.

These curves have been derived by taking 9-year averages. That is, each point in the curve representing a year is the average of that year as well as of the four years preceding and of the four years following, except near the ends of the curve, where the number of adjacent years included in the average is necessarily fewer. This

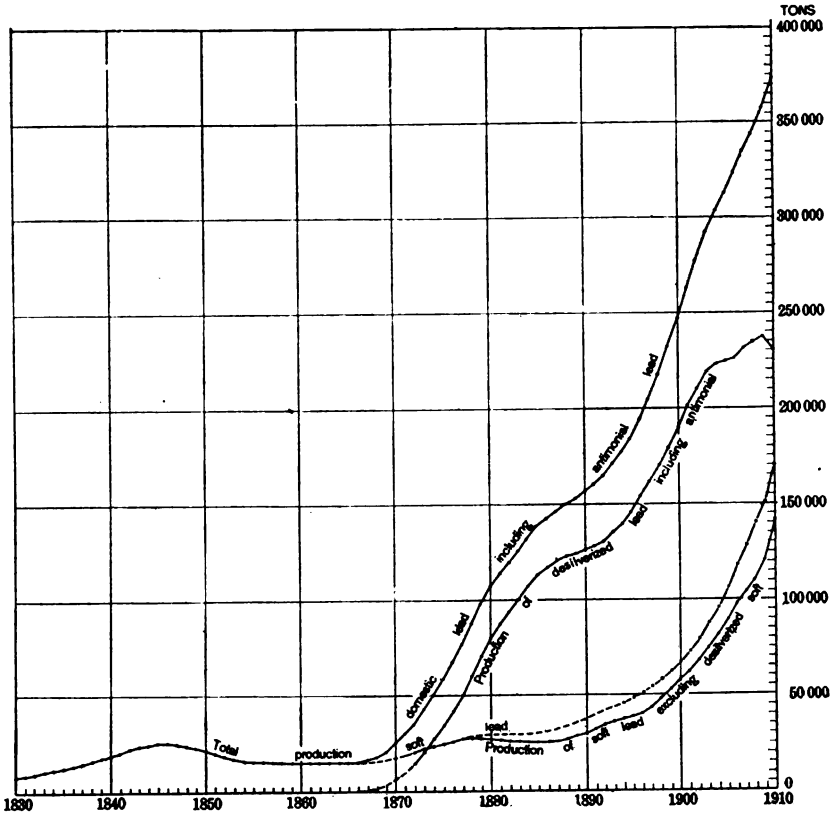

FIGURE 1.—Diagram showing domestic lead production in the United States, 1830-1910.

method practically eliminates the yearly vicissitudes of production and yields a natural curve of the periodic trend of the industry

PRODUCTION BY STATES.

The following table showing the production of lead by States is taken, with the exceptions indicated, from two sources which in themselves involve somewhat different methods of compilation. The figures for years prior to 1894 are from the trade statistics of E. A. Caswell, and are in terms of refined lead. Compiled from reports by smelters and transportation companies, they probably represent to a

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certain extent the locality where smelted rather than that of the origin of the ore, but for the period involved these two items must have nearly coincided. For the years 1894 to 1905, inclusive, the figures have been collected by the United States Geological Survey. They were compiled from smelter reports and it should be noted that they represent the content of the ores and not the actual recovery, which is the quantity available for consumption. The latter quantity, termed "merchant lead," may be estimated from the figures of lead content by deducting therefrom a proper allowance for losses in smelting, desilverizing, and refining.

Production of lead by States, 1873–1905, in short tons.

Year.	Argentiferous lead.										Mississippi Valley soft lead.		
	Colorado.	Utah.	Montana.	Idaho.	California.	Arizona.	New Mexico.	Washington.	Nevada.	Other Western States.	Missouri-Kansas.	Southeast Missouri.	Wisconsin-Illinois.
1873	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	15,045	.....	7,336
1874	312	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,400
1875	818	.....	.....	.....	.....	.....	.....	.....	.....	.....	19,099		5,600
1876	667	.....	.....	.....	.....	.....	.....	.....	.....	.....	19,225		7,196
1877	897	24,194	2,912	.....	3,918	.....	.....	.....	19,724	(a)	15,422	9,312	6,418
1878	5,824	21,627	456	.....	4,320	.....	.....	.....	31,063	(a)	11,761	10,517	4,492
1879	22,783	14,370	2,431	.....	2,251	.....	.....	.....	22,805	(a)	14,182	11,158	2,800
1880	34,240	15,214	1,922	.....	2,100	.....	.....	.....	16,659	(a)	15,780	7,970	3,940
1881	42,516	23,973	3,360	.....	3,340	.....	.....	.....	12,826	(a)		30,770	
1882	60,988	29,947	.....	.....	.....	.....	.....	.....	8,590	3,700		29,015	
1883	70,800	33,330	.....	.....	.....	.....	.....	.....	5,775	15,840		21,600	
1884	72,600	30,432	7,470		.....	.....	.....	.....	.....	14,718		18,140	
1885	53,500	29,160	10,993		.....	.....	.....	.....	.....	20,600		21,265	
1886	48,480	24,332	12,632		.....	.....	.....	.....	.....	19,500		22,460	
1887	55,722	22,900	16,000		.....	.....	.....	.....	.....	22,400		27,958	
1888	56,916	22,283	31,400		.....	.....	.....	.....	.....	15,201		31,252	
1889	54,288	31,180	28,400		.....	.....	.....	.....	.....	13,709		27,400	
1890	51,450	34,132	18,300		.....	.....	.....	.....	.....	10,664		33,840	
1891	58,950	43,360	28,000		.....	.....	.....	.....	.....	20,168		29,763	
1892	48,400	45,553	32,600		.....	.....	.....	.....	.....	21,527		32,895	
1893	46,800	35,043	20,045		.....	.....	.....	.....	.....	24,900		32,859	
1894	50,613	23,190	9,637	33,308	478	1,480	2,973	.....	2,254	150		46,300	
1895	46,984	31,305	9,802	31,638	949	2,053	3,040	.....	2,583	381		53,596	
1896	44,803	35,578	11,070	46,662	691	1,165	3,461	.....	1,173	1,006		51,887	
1897	40,576	40,537	12,930	58,627	383	2,184	9,123	.....	959	638		56,542	
1898	57,352	39,299	10,745	59,142	482	2,224	5,797	.....	4,714	1,349		54,469	
1899	70,308	29,987	10,227	52,154	487	3,377	4,856	.....	3,388	862		54,444	
1900	82,137	48,044	.....	85,444	520	.....	.....	.....	.....	.....		.....	
1901	73,265	49,870	5,791	79,654	381	4,045	1,124	.....	1,873	1,029		67,172	
1902	51,833	53,914	4,438	84,742	175	599	741	1,457	1,269	2,184		79,445	
1903	45,554	51,129	3,303	99,590	55	1,493	613	538	2,237	1,765		86,597	
1904	51,884	56,470	3,635	108,854	163	1,499	1,363	622	1,873	41		92,275	
1905	56,638	44,996	2,207	99,027	116	2,091	1,232	56	2,206	101		104,058	

a Included under Montana.

The closer distribution of the lead production among the States from which the ore was derived, which was begun in 1906, has necessitated the separate table which follows. The product of refined lead can with difficulty be apportioned according to sources of ore, owing to the fact that lead refiners treat smelted products whose origin may, as in custom refining, be unknown to them, the identity of the ore and thus its original source being preserved only as far as the smelter. Accordingly, this table, showing sources of lead smelted or refined in the United States, is based as far as possible on smelter figures. It includes "pig lead" reported by all known smelters running on Mis-

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sissippi Valley or southern lead ores, and "lead" produced at all other lead smelters in this country. The greater part of the product reported by smelters operated in conjunction with refineries is in terms of refined lead. A like part of the antimonial lead product is thus eliminated from the "lead" produced and appears only in the figures of production of antimonial lead. No lead ore from the United States was treated elsewhere during the period covered by the table.

Sources of primary lead smelted or refined in the United States, 1906–1910, in short tons.

Source of ore.	1906	1907	1908	1909	1910	
	Quantity.	Quantity.	Quantity.	Quantity.	Quantity.	Percentage of total.
Domestic ore:						
Alaska	8	.....	3	60	60	0.02
Arizona	2,884	2,340	1,464	1,465	858	.23
Arkansas	.....	15	.....	14	.....	.....
California	432	854	515	937	1,160	.31
Colorado	50,497	48,876	28,728	29,326	35,685	9.61
Georgia	.....	2	.....	.....	.....	.....
Idaho	117,117	112,569	98,464	97,183	99,924	26.84
Illinois	572	498	363	273	262	.07
Iowa	270	225	110	15	.....	.....
Kansas	1,932	1,798	2,293	2,764	1,308	.35
Kentucky	44	75	.....	.....	50	.01
Missouri	111,075	122,856	122,451	142,650	161,659	43.43
Montana	2,435	2,035	2,320	1,376	1,790	.48
Nevada	1,609	3,330	3,796	4,698	2,195	.59
New Hampshire	.....	.....	.....	5	.....	.....
New Mexico	640	1,927	586	1,275	1,731	.47
Oklahoma	.....	404	1,409	2,268	1,805	.48
Oregon	.....	.....	7	6	.....	.....
South Dakota	.....	.....	13	.....	7	.002
Tennessee	11	16	.....	.....	.....	.....
Texas	25	10	42	42	33	.008
Utah	56,260	61,699	42,455	64,534	57,061	15.33
Virginia	.....	82	13	.....	87	.02
Washington	46	231	391	115	311	.08
Wisconsin	1,753	3,551	4,013	3,238	3,884	1.04
Undistributed	380	355	36	303	288	.08
Zinc residues	2,053	1,318	1,290	1,641	2,049	.55
Total from domestic ore.	350,153	365,166	310,762	354,188	372,227	100.00
Foreign ore:						
Africa	.....	323	.....	3,227	3,499	.....
Canada	7,238	5,793	341	71	44	.....
Central America	112	.....	12	25	7	.....
China	18	.....	4	.....	.....	.....
Mexico	21,435	36,749	38,729	69,100	70,159	.....
South America	.....	911	1,186	1,574	3,168	.....
Other foreign	.....	149	.....	38	28	.....
Foreign base bullion:						
Canada	.....	.....	.....	1,816	.....	.....
Mexico	39,743	32,924	57,489	27,006	31,648	.....
Total from foreign ore and base bullion	68,546	76,849	97,761	102,857	108,553	.....
Grand total, derived from all sources	418,699	442,015	408,523	457,045	480,780	.....

SOFT LEAD.

The lead ores of the Mississippi Valley are almost free from silver and the lead produced from them is known as "soft lead." A little lead ore derived from Washington and other Western States is also of this character. All but one of the smelters running exclusively on these soft-lead ores do not desilverize their product. Their output is shown in the "soft lead" column of the general table of

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refined lead production for 1825–1910, which is given on a preceding page. However, considerable quantities of the soft lead ores have been annually smelted by the silver-lead smelters, and, in addition, since 1904 one of the Mississippi Valley smelters has regularly desilverized its product. This desilverized soft lead, for the years prior to 1906, has not been kept separate from the lead produced from silver-lead ores, though the lead content of the soft-lead ores so smelted has been recorded since 1894. Since 1906 the quantity of soft lead produced by each State has been recorded as shown in the tables below. In the table immediately following, the output of the soft-lead smelters is given in the first column and the lead content of soft-lead ores smelted and desilverized is given in the second column. For the years 1904 and 1905, a portion of the quantity given in the second column represents lead content of ore and a portion is refined lead. From 1906 to the present the only quantity given is that of refined lead.

In order to give a fair notion of the annual quantity of refined pig lead recovered from soft-lead ores, the lead recovered from such ores by the silver-lead smelters has been estimated at the rate of recovery used in the official reports for those years. Even so the figures do not give the total amount of lead recovered from soft-lead ores. To give the total recovered soft lead there must be taken into account the lead recovered in the form of pigments, as these are made from soft-lead ores. On this basis the soft lead recovered in 1910 constituted 47 per cent of the total domestic lead production.

Production of soft lead in the United States, 1894–1910, in short tons.

Year.	Undesilverized.	Desilverized.		Total soft lead.
		Lead contents of ore.	Recovered lead.	
1894	37,686	[a] 8,614	[b] 8,097	[b] 45,783
1895	39,890	[a] 13,706	[b] 12,884	[b] 52,774
1896	43,537	[a] 8,350	[b] 7,849	[b] 51,386
1897	43,553	[a] 12,989	[b] 12,210	[b] 55,763
1898	42,779	[a] 11,688	[b] 10,987	[b] 53,766
1899	40,566	[a] 13,878	[b] 13,045	[b] 53,611
1900	48,021	[a] 11,500	[b] 10,810	[b] 58,831
1901	57,898	[a] 9,274	[b] 8,718	[b] 66,616
1902	74,050	[a] 5,395	[b] 5,071	[b] 79,121
1903	83,444	[a] 3,153	[b] 2,961	[b] 86,408
1904	89,169	[c] 5,320	[b] 5,165	[b] 94,334
1905	85,455	[c] 18,603	[b] 18,556	[b] 104,011
1906	90,860	.....	25,000	115,860
1907	99,948	.....	29,809	129,757
1908	101,013	.....	29,869	130,882
1909	118,802	.....	32,420	151,222
1910	141,318	.....	27,926	169,244

[a] Lead content of ores smelted and desilverized.
[b] Estimated recovery of lead from lead content of ore.
[c] In part lead content of ores, in part refined lead.

The table below shows the production of soft lead, by States, for the period 1906–1910, which is as far back as the records of the individual production of the Mississippi Valley States are available. These figures include both plain and desilverized soft lead, but do not include the lead content of pigments.

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Production of soft lead in the United States in 1906–1910, by States, in short tons.

Source of ore.	1906	1907	1908	1909	1910
Arkansas	.....	15	.....	14	.....
Illinois	572	498	363	273	262
Iowa	270	225	110	15	.....
Kansas	1,932	1,798	2,293	2,764	1,808
Kentucky	44	75	.....	.....	50
Missouri	111,075	122,856	122,451	142,650	161,659
Oklahoma	.....	404	1,409	2,268	1,805
Tennessee	11	16	.....	.....	.....
Virginia	.....	82	13	.....	87
Washington	19	87	230	.....	189
Wisconsin	1,753	3,551	4,013	3,238	3,884
Undistributed	184	150	.....	.....	.....
Total	115,860	129,757	130,882	151,222	169,244

ANTIMONIAL LEAD.

The production of antimonial lead from ores derived from all sources, as reported by all desilverizers operating in this country, is shown in the following table:

Production of antimonial lead in the United States from 1891 to 1910, in short tons.

1891	4,043	1901	10,656
1892	5,039	1902	9,169
1893	5,013	1903	9,579
1894	.....	1904	11,001
1895	.....	1905	10,995
1896	7,507	1906	10,546
1897	8,867	1907	9,910
1898	8,473	1908	13,629
1899	6,345	1909	12,896
1900	9,906	1910	14,069

Antimonial lead was valued at $1,338,090 in 1910, against $1,231,019 in 1909, $1,264,771 in 1908, and $1,322,985 in 1907.

The antimonial content of the antimonial lead produced in 1907 was estimated at 1,561 tons. For later years the antimony content of the antimonial lead has been returned by the smelters, being reported as 2,440 tons in 1908, as 2,360 tons in 1909, and as 2,229 tons in 1910. This antimony is in part of domestic origin and in part of foreign origin, the exact distribution as between these sources being difficult or even impossible to determine. Further details as to the production and consumption of antimony in the United States may be gleaned from the chapter on antimony in this volume.

LEAD PIGMENTS.

In addition to the leaded zinc oxide and zinc-lead oxide pigments, which are noted more particularly in connection with the production of zinc pigments, there are two lead pigments which are produced directly from ore, namely, sublimed white lead and sublimed blue lead. Sublimed white lead consists of lead sulphate 75 per cent, lead oxide 20 per cent, and zinc oxide 5 per cent. Sublimed blue lead consists of lead sulphate 50 to 53 per cent, lead oxide 41 to 38 per cent, with small proportions of lead sulphide, lead sulphite, and zinc oxide. Zinc-lead oxide contains from 46 to 50 per cent of lead sulphate, from 52 to 46 per cent of zinc oxide, and a small amount of zinc sulphate. Leaded zinc oxide may vary from 4 to 20 per cent in lead sulphate, the remainder being zinc oxide with a small portion of zinc sulphate.

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The total lead contents of the 1910 production from domestic ores of the above-mentioned pigments was 7,603 short tons, as compared with 7,292 tons in 1909, with 7,377 tons in 1908, and with 6,574 tons in 1907.

The St. Louis Smelting & Refining Co. in 1909 completed as an adjunct to the lead smelter at Collinsville, Ill., a plant for the manufacture of sublimed lead pigments directly from ore. The pigment works were temporarily closed early in 1910 by an injunction secured by the Picher Lead Co. on the ground of infringement of patents controlled by the latter company. The case is still in litigation.

SECONDARY LEAD.

Important sources of lead are skimmings, drosses, old metal, and alloys, as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral portion of the lead industry. This business is mostly carried on at small refineries scattered over the United States, but the large smelters and refineries working primary lead frequently find it advantageous to incorporate material from secondary sources. In such cases it has been noted on the reports of the smelters to the Survey, and to that extent the production of secondary lead has always been taken into account. Since 1907, however, statistics have been collected from the secondary refineries, for the first two years by the writer, and for the last two years by J. P. Dunlop, of the United States Geological Survey. In 1907 and 1908, reports were obtained from the larger plants only, but in 1909 the scope of the canvass was greatly enlarged and the number of firms reporting was increased from 44 to 100, with the result that the figures of production for both 1909 and 1910 show a great increase. The product of such secondary refineries is of two classes, pig lead and lead in alloys. In the latter case the lead may have been recovered in the form of pig lead and alloyed at the refinery or it may have been refined as an alloy, being brought to the desired composition by addition of the requisite metal.

Production of secondary lead in the United States in 1907–1910, in short tons.

	1907	1908	1909	1910
Pig lead	9,990	7,990	17,822	29,384
Lead in alloys	15,508	10,543	23,327	25,939
Total recovered lead	25,498	18,533	41,149	55,323

COMPARISON OF STATE TOTALS BASED ON SMELTER RETURNS AND ON MINE REPORTS.

The foregoing figures of the production of metallic lead by the respective States are compiled from reports of individual lead smelters and refineries. For several years the production of the more valuable metals in the Western States has been obtained by the Survey from reports of individual mines. In 1906 the same method was followed in the Eastern States, and in 1907 the plan was extended to take in the whole country. In order to put the smelter production on the same basis as the mine figures, all the lead which was produced as pigments directly from ore is added to the production of metallic lead. The lead recovered from secondary sources is excluded from these totals, since it has already been reckoned once as pig lead.

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These facts must be borne in mind in comparing this table with the preceding tables. The State totals obtained by each method for the last four years are compared in the following table:

Comparison of State totals compiled from smelter and mine returns, 1907–1910, in short tons.

State.	1907				1908			
	Totals based on smelter reports.	Totals based on mine reports.	Differences.		Totals based on smelter reports.	Totals based on mine reports.	Differences.	
			Smelter excess.	Mine excess.			Smelter excess.	Mine excess.
Alaska					3		3	
Arizona	2,350	2,330	20		1,464	1,504		40
Arkansas	15	12	3			15		15
California	854	1,313		459	515	619		104
Colorado	50,596	42,703	7,893		30,852	26,100	4,752	
Idaho	112,569	116,912		4,343	98,464	103,414		4,950
Illinois	509	830		321	363	399		36
Iowa	225	242		17	110	51	59	
Kansas	1,929	2,555		626	2,825	2,518	307	
Kentucky	75	34	41					
Missouri	127,373	138,675		11,302	127,620	144,459		16,839
Montana	2,035	1,874	161		2,320	2,298	22	
Nevada	3,380	3,136	244		3,796	3,623	173	
New Mexico	2,126	1,905	221		586	437	149	
Oklahoma	476	532		56	1,577	1,781		204
Oregon					7	1	6	
South Dakota					13	12	1	
Tennessee	16		16					
Texas	10	12		2	42	33	9	
Utah	62,073	57,969	4,104		42,455	44,389		1,934
Virginia	a 84	a 70	14		13	38		25
Washington	346	410		64	593	575	18	
Wisconsin	3,551	3,499	52		4,107	4,138		31
Undistributed	355				36			
Zinc residues	1,318				1,290			
Total	372,265	375,013			319,051	336,404		

State.	1909				1910			
	Totals based on smelter reports.	Totals based on mine reports.	Differences.		Totals based on smelter reports.	Totals based on mine reports.	Differences.	
			Smelter excess.	Mine excess.			Smelter excess.	Mine excess.
Alaska	60	19	41		60	28	32	
Arizona	1,465	1,549		84	858	1,348		490
Arkansas	14	24		10		63		63
California	937	751	186		1,160	1,435		275
Colorado	30,912	36,084		5,172	37,007	38,036		1,029
Idaho	97,183	107,993		10,810	99,924	114,129		14,205
Illinois	273	295		22	262	373		111
Iowa	15	36		21		20		20
Kansas	3,085	1,300	1,785		1,581	2,412		831
Kentucky		10		10	50	41	9	
Missouri	147,372	159,435		12,063	166,617	161,016	5,601	
Montana	1,376	1,492		116	1,790	2,053		263
Nevada	4,698	4,920		222	2,195	2,436		241
New Hampshire	5		5					
New Mexico	1,275	2,515		1,240	1,731	2,160		429
Oklahoma	2,820	3,427		607	2,612	2,888		276
Oregon	6		6					
South Dakota		59		59	7	7		
Texas	42	46		4	33	33		
Utah	64,534	74,243		9,709	57,061	61,662		4,581
Virginia					87	99		12
Washington	115	144		29	311	661		350
Wisconsin	3,349	3,694		345	4,127	4,413		286
Undistributed	303				288			
Zinc residues	1,641				2,049			
Total	361,480	398,036			379,830	395,313		

a Includes, also, production of Georgia and New Hampshire.

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The smelter totals represent actual recovery and are found by summing up the total production reported by all companies for each State, respectively, and recalculating all pigments back to equivalent metalic lead on the basis of average analysis of product. In compiling the mine totals each producing property is requested to report actual tonnage of lead ores and concentrates shipped, and from this tonnage the lead content is reckoned by assay value. The quantities thus obtained from all the producing properties in each State are combined to make the total for that State. It is clear that by either method the correctness of the totals is dependent upon complete and correct returns from every producing mine and smelter. It is further essential to the correctness of the mine totals that the assay content be correctly estimated.

With equal conditions affecting the mines and the smelters, the stocks in the ore bins of the smelters should run about even from year to year, and the mine and smelter State totals, making allowance in the former for losses in smelting, should show reasonable agreement. As may be seen from the table, however, there are frequent discrepancies. The causes of these discrepancies fall into four categories. The first is lag, by which is meant the time that elapses between the shipment of ore by the mine and the reduction of the ore by the smelter. This is frequently considerable, for ore raised near the end of the year may remain in the stock bins of the smelter until the succeeding year and, unless balanced by an equivalent lag from the preceding year, will thus lead to an apparent "mine excess." As this chapter is being prepared there are reports in the mining journals of the accumulation of 20,000 tons of lead ore at a western smelter now under construction but which may not blow in until 1912. The lead content of this ore will therefore appear as "mine excess" in the 1911 reports for the Western States furnishing the ore. If through accident, business depression, or otherwise, the mines close down, the smelters largely consume their ore stocks, which results in an apparent "smelter excess." The second source of difference is found in error in the mine totals, either in ore tonnage or in the arbitrary calculation of metal content from assay. The dry assay in vogue in the Western States gives results uniformly too low. A decision of the United States circuit court (T. D. 21653) recognizes a differential of 1.5 per cent between the dry assay and chemical analysis, and in actual practice the discrepancy is probably even greater than that figure. A third source is found in failure of the smelter returns to segregate accurately the ore from the different States. Until 1906 the ore coming from the Joplin district was lumped by the smelters as from Missouri or Missouri-Kansas, though some of it was from Oklahoma. This tended to make a smelter excess for Missouri and a mine excess for Kansas and Oklahoma. The same custom was to a certain extent true of the upper Mississippi Valley district. Though apportioned to the proper States since 1906, the division is confessedly a rough estimate in the case of some of the smelters which do not keep the ore from these regions separate on their books. Lastly, there is not taken into account in these totals the loss in smelting, ranging from 2 to 5 per cent in treating easily reducible ores and up to 10 or more per cent in the more refractory ores. Losses running over 20 per cent have been claimed in smelting ores running high in antimony and arsenic. Lag

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being left out of account, each State would normally show a mine excess equal to this smelting loss. Any discrepancy which appears in the table may reasonably be ascribed to one or more of these items. In the long run, barring error and allowing for smelting losses and exportation or ore, the "mine excess" will be balanced by equivalent "smelter excess."

SMELTER AND MINE STATE TOTALS IN 1910.

As no allowance for smelting losses has been made in the mine totals, only those mine excesses which are notably above the normal loss in smelting need be discussed here. The mine excesses in Arizona and California are apparently due to lag in smelting. The mine excess in Colorado is no doubt due to the same cause, as large stocks of mixed sulphide ores of lead and zinc are known to be accumulated at separating plants and smelters. The mine excess in Idaho is probably also to be attributed to accumulation of ore from that State at lead smelters. The small mine excess in that State in 1909 followed two years in which the mine excesses were below the normal smelting loss and during which the smelter stocks must have been depleted. The mine excesses in Illinois, Kansas, and Oklahoma are likely due to errors in distribution by the smelters. The large smelter excess in Missouri, following two years showing large mine excesses, which must have been represented by accumulated ore stocks at the smelters, is probably to be interpreted as the reduction of those stocks to normal proportions. The mine excesses in New Mexico and Washington are apparently due to lag in smelting, and that part of the mine excess in Utah above the smelting loss is probably due to the same cause.

RESOURCES.

MINE PRODUCTION OF LEAD IN UNITED STATES IN 1910.

The following table shows for each lead-producing State the total quantity of lead-bearing ores produced and the output of each kind of lead-bearing ore. The column headed "All other ores" includes copper ore, copper-lead ore, and dry or siliceous ore. "Dry" ores produced in Colorado contained 12,949 short tons of lead out of a total of 13,409 tons of lead contained in "all other" ores. The total crude ore yielding either gold, silver, copper, lead, or zinc is given for each lead-producing State, so that a comparison may be made of the relative extent of deep mining operations in these States, the quantity of crude ore raised being the best measure for this purpose. As shown by the table, Missouri takes the same dominating position in the production of crude lead ore and lead-bearing zinc ores that was noted in the discussion of the table showing source of zinc mined in the United States in 1910 as given in the chapter on zinc in this volume. Missouri produced about two-thirds of the crude lead ore and three-fourths of the crude lead-bearing zinc ore mined in the United States in 1910, and occupied the first rank in output of crude ore carrying any or all the five metals named above.

The table gives also the quantity of lead contained in the crude ores of each State and the lead content of each kind of lead-bearing ore. The percentage of lead contained in the lead ore, the lead-zinc

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ore, and zinc ore of each State is also given. The lead content of lead ores ranges from 43.2 per cent in Washington down to 3.5 per cent in Missouri, the average for all the States being 5.3 per cent. The lead-zinc ores were somewhat richer in lead than the lead ores, averaging 5.9 per cent. The average lead content of zinc ores was 0.4 per cent, this low figure being due to the preponderance of low-grade lead-bearing zinc ores in the Central States. An odd coincidence brought out by the table below and the similar table in the zinc report is that the crude zinc ore of Wisconsin shows exactly the same percentage of lead and of recoverable zinc as does the total crude zinc ore of the United States. Of the total mine production of lead in 1910, a quantity corresponding to 77.3 per cent was derived from lead ores, 7.5 per cent was derived from lead-zinc ores, 10.6 per cent was derived from zinc ores, and 4.6 per cent was recovered from all other ores. The figures of mine production of lead are taken from the chapters appearing elsewhere on mine production of gold, silver, copper, lead, and zinc in the various States.

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Source of lead mined in the United States in 1910, by States and kinds of ore, in short tons.

State.	Lead ores.			Lead-zinc ores.			Zinc ores.			All other ores.		Total.	
	Crude ore.	Lead content.	Percentage.	Crude ore.	Lead content.	Percentage.	Crude ore.	Lead content.	Percentage.	Crude ore.	Lead content.	Crude ore.	Lead content.
Alaska										78,005	28	78,005	28
Arizona	6,240	792	12.7				7,650	251	3.3	3,901,079	305	3,914,969	1,348
Arkansas							35,000	63	.2			35,000	63
California	19,004	1,420	7.5							2,678,881	15	2,697,885	1,435
Colorado	133,323	11,957	9.0	244,414	11,803	4.8	82,251	867	1.1	1,974,676	13,409	2,434,664	38,036
Idaho	1,566,561	113,823	7.3				34,006	300	.9	185,607	6	1,786,174	114,129
Illinois							111,078	101	.1	(a)	272	a 111,078	373
Iowa							b 5,110	20	.4			b 5,110	20
Kansas							704,046	2,412	.3			704,046	2,412
Kentucky							b 30			b 5,140	41	b 5,170	41
Missouri	3,693,523	130,637	3.5				9,054,897	30,379	.3			12,748,420	161,016
Montana	5,951	758	12.7	30	5	16.7	169,165	68	.0	4,904,300	1,222	5,079,446	2,053
Nevada	16,805	1,964	11.7	1,663	214	12.9	3,038	59	1.9	3,634,269	199	3,655,775	2,436
New Mexico	4,084	781	19.1	24,685	1,346	5.5	20,944			142,152	33	191,865	2,160
Oklahoma							223,212	2,888	1.3			223,212	2,888
South Dakota										1,528,929	7	1,528,929	7
Texas	28	11	39.3							21,889	22	21,917	33
Utah	329,058	42,698	13.0	231,278	16,255	7.0	4,954	111	2.2	5,834,108	2,598	6,399,398	61,662
Virginia	6,400	99	3.1				10,066			510		16,976	99
Washington	1,530	661	43.2							57,679		59,209	661
Wisconsin							1,032,052	4,413	.4			1,032,052	4,413
Total	5,782,507	305,601	5.3	502,070	29,623	5.9	11,497,499	41,932	.4	24,932,824	18,157	42,714,900	395,313
Percentage of total lead derived from each kind of ore		77.3			7.5			10.6			4.6		100.0

a Lead concentrates are obtained as by-product in the milling of fluorspar ore in southern Illinois, but the tonnage of crude fluorspar would not properly be classified among "All other ores" and is therefore omitted.
b Estimated.

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REVIEW BY DISTRICTS.

For details of production in the several lead-producing districts of the United States the reader is referred to the mines reports for the individual States appearing elsewhere in the volume of which this is a chapter. Only the general trend of development during the year will be here considered in connection with the different districts.

In the Eastern States unnumbered veins of lead have been prospected and worked spasmodically, though in but two States have these operations developed into the caliber of lead mines.

In New York lead ore has been mined in quantity in the northern part of the State, in the Rossie district, and in the southern part of the State, near Ellenville, Wurtzboro, and Guymard, but no lead has been produced in recent years.

The Virginia lead ores have been known and mined for more than 150 years, the mines at Austinville being the oldest workings. Lead ore, associated with zinc, occurs at the Pulaski, Austinville, Cedar Valley, and Albemarle mines. The production of lead by Virginia mines in 1910 was 99 short tons—larger than the output for several years past.

The Kentucky-Illinois fluorspar region yields some lead ore, mostly obtained as concentrates in the reduction of crude fluorspar. The production of lead from this source has been unimportant in the last few years, owing to the depression in the fluorspar industry. The recent enlargement of fluorspar concentrating plants in southern Illinois will no doubt lead to an increase in the output of lead concentrates from that region.

The upper Mississippi Valley region, embracing adjoining portions of Wisconsin, Illinois, and Iowa, was the scene of some of the earliest lead mining in the United States. The mines were at first worked exclusively for lead, but since 1860 the production of zinc ore has predominated over that of lead ore, with which the zinc ore is associated in many mines. The lead content of lead concentrates produced in the district in 1910 was 4,534 short tons, as compared with 3,718 tons in 1909.

The southeast Missouri disseminated lead region has in recent years made the greatest gains in production of all the lead-producing districts of the United States, and since 1908 has annually exceeded the production of the Coeur d'Alene region, which formerly held first rank. The ore of the southeast Missouri region is almost wholly lead ore, although, particularly in the southern portion of the area, there is in many places considerable copper, nickel, and cobalt mixed with the lead. These occur in sufficient quantity to constitute the chief value of the ore in the North American mine at Fredericktown. An increasing quantity of zinc blende is also being found in the ore, ranging in the lead concentrates from a trace up to 5 per cent. Several of the milling plants remove the zinc as a table middling in concentration, and others similarly treat the copper-nickel-cobalt sulphides. The latter are salable, but no zinc recovered from the disseminated lead ore has as yet been marketed. Silver also occurs in the ore to the extent of a little over 1 ounce to the ton of lead concentrates. The ore occurs in disseminated bodies of large size at depths ranging from 100 to 550 feet, though at a fairly definite geologic horizon. The crude ore in 1910 yielded 5.7 per cent of

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lead concentrates, which carried an average of 62.3 per cent of lead. The production in 1910 was practically the output of six companies in St. Francois and Madison Counties. Three other companies in Madison County were in financial difficulties and made no production. The first new company to begin deep mining in this district in several years is the Potosi Lead Co., which, early in 1910, began a shaft near Leadwood. The lead content of the lead ore mined in the southeast Missouri region in 1910, including also a small quantity from shallow lead mines in adjoining counties, was 131,499 short tons, as compared with 128,299 tons in 1909 and with 116,531 tons in 1908.

The Joplin region includes southwest Missouri, southeast Kansas, and northeast Oklahoma. This is the greatest zinc-producing area in the United States, furnishing 45 per cent of the total recoverable zinc production of 1910. The lead output is practically all recovered as a by-product in concentrating the zinc ores. The lead content of the lead concentrates produced in the Joplin region in 1910 was 34,817 short tons, as compared with 35,863 tons in 1909 and with 32,227 tons in 1908. The lead production of southwest Missouri was considerably curtailed by the closing down of many sheet-ground mines in the latter part of the year on account of the low price of zinc. Oklahoma likewise had a smaller lead production, but Kansas made a good gain.

Northern Arkansas made a small quantity of lead ore in concentrating zinc ores.

New Mexico mines produced 2,160 tons of lead in 1910, as compared with 2,515 tons in 1909. The principal part of the lead came from the Magdalena zinc-lead district in Socorro County. The decrease in 1910 was caused chiefly by the idleness of the lead mines of the Organ district in Dona Ana County.

Colorado showed an increase in the mine production of lead, with an output of 38,036 tons in 1910, as compared with 36,084 tons in 1909. Lake County (Leadville district) led in the production of this metal by furnishing one-fourth of the total, but fell off considerably from the 1909 production. Pitkin County (Aspen district) ranked second, with San Juan (Animas and Eureka districts) and San Miguel (upper San Miguel district) counties in order. About 20 counties produced more or less lead in 1910.

Montana made a good increase in lead production in 1910, the output being 2,053 tons, as compared with 1,492 tons in 1909. This production came chiefly from Jefferson County, which furnished nearly half the total output. The remaining production was distributed among 12 counties. The lead from Jefferson County was derived principally from the silver-lead mines of the Elkhorn district.

Idaho mines produced 114,129 tons of lead in 1910, as compared with 107,993 tons in 1909, a gain of about 6 per cent. This gain was about equally divided between Shoshone County (Cœur d'Alene district) and Lemhi County (Texas district). The lead production of the latter county was thus increased from 66 tons in 1909 to 3,263 tons in 1910. A factor in the improvement was the completion of additional transportation facilities for these two counties. A small lead smelter was constructed at Enaville to handle ores from the northern part of the Cœur d'Alene district.

Utah mines fell off heavily in lead production in 1910, the total lead product being 61,662 tons, as compared with 74,243 tons in 1909. The counties responsible for this loss were Summit and Wasatch,

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embracing the Park City district, and Utah and Juab, which include Tintic district. The Tintic district in particular suffered a loss of over 30 per cent in lead production. This was principally due to a change in the mineralogical constitution of one of the large ore shoots, by which the lead production of the mine was greatly reduced. The chief lead-producing counties making gains were Beaver (San Francisco district), Salt Lake (Bingham and Cottonwood districts), and Tooele (North Tintic and other districts).

Arizona had a somewhat smaller lead production in 1910 than in 1909, the figures being 1,348 tons and 1,549 tons, respectively. This production was mostly from Cochise County, with smaller quantities from Mohave, Yavapai, Pima, and several other counties. The chief lead-producing areas of Cochise County are the Warren and the Tombstone districts. The 1910 output came mainly from the Copper Queen mine, in the former district, and from the 700-foot and 800-foot levels of the Tombstone mine, in the latter district. The lower levels of the Tombstone mine were flooded in 1909 and had not been drained at the close of 1910. In Mohave County the principal lead output came from the Golconda mine in the Union Basin district, a mine also yielding zinc and described more fully in the chapter on zinc. In Yavapai County the chief lead production came from the Big Bug and the Walker districts, and in Pima County from the Pima district.

The Nevada mine production of lead fell off over one-half in 1910, the figures being 2,436 tons in 1910 and 4,920 tons in 1909. This output was derived chiefly from Clark County from the Yellowpine district, also the heaviest zinc-producing district in the State. Smaller outputs came from Eureka County (Eureka district), Lincoln County (Pioche district), Mineral County (Hawthorne district), and White Pine County. The completion of concentrating mills in the Yellowpine district and the addition of a Huff separating plant to the concentrating mill at Needles, Cal., will make available deposits which have not heretofore been worked and should materially increase the production of both lead and zinc.

California mines in 1910 doubled the lead production of the preceding year, having an output of 1,435 tons, as compared with 751 tons in 1909. This quantity was obtained almost altogether from Inyo County, which had 10 producing silver-lead mines in 1910.

Washington's production of lead in 1910, although small, was the largest which the State has had in recent years. It amounted to 661 tons, as against 144 tons in 1909. Practically all of this output came from Stevens County and was derived chiefly from the Northport district, with a smaller quantity from the Bossburg district. The lead ore of the Northport district is nonargentiferous and was shipped to the soft-lead smelters of the Mississippi Valley. The Jupiter mine was the principal producer.

METALLURGY.

CONCENTRATION AND SEPARATION.

The problems of concentration and separation of lead ores do not differ essentially from those concerning zinc ores or the complex sulphide ores of lead and zinc. The various adaptations of the principles of flotation and of electrostatic separation to such ores have been discussed in the chapter on zinc in "Mineral Resources of the United States for 1910," to which the reader is referred.

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SMELTING.

LEAD SMELTERS AND REFINERIES IN 1910.

In the following list the attempt has been made to give all the lead smelters and refineries in existence or under construction in the United States in 1910. The lead plants of the International Smelting & Refining Co. are also included, although their construction was authorized after the close of 1910. The plants which produced in 1910 are given in ordinary type; those which were not in operation are listed in italics. The list includes several leaching and other chemical-process plants, the character of which is noted. Plants which desilverize and otherwise refine lead are also given.

List of lead smelters and refineries in the United States in 1910.

ARIZONA:
Mayer—*Rigby Mining & Smelting Co.*[1] (Chloridizing roast process.)
Mowry—*Consolidated Mines, Smelter & Transportation Co.*[1]
CALIFORNIA:
Keeler—Four Metals Mining & Smelting Co.
Needles—Needles Mining & Smelting Co.[2]
Selby—Selby Smelting & Lead Co.[3] Refinery also.
COLORADO:
Buena Vista—Kuenzel's Process Co. Under construction.
Denver—Globe plant, American Smelting & Refining Co.
Durango—Durango plant, American Smelting & Refining Co..
Georgetown—Western Metals Co. (Malm dry chlorination process.) Under construction.
Lake City—Demonstration plant. (Rankin nitric acid leaching process.) Under construction.
Leadville—Arkansas Valley plant, American Smelting & Refining Co.
Pueblo—Pueblo plant, American Smelting & Refining Co.
Salida—Ohio & Colorado Smelting Co.
IDAHO:
Enaville—North Fork Smelting & Mining Co. Under construction.
Hahn—Lemhi Smelting Co.
Ponderay—*Idaho Smelting & Refining Co.*
Sea Foam—*Greyhound Mining & Milling Co.*
ILLINOIS:
Aurora—Aurora Metal Co.[4]
Chicago—National plant, American Smelting & Refining Co. Refinery only.
Collinsville—St. Louis Smelting & Refining Co.[5] Refinery also.
Federal—Federal Lead Co.[3]
Granite City—Hoyt Metal Co.[4]
INDIANA:
Grasselli—United States Metals Refining Co.[2] Refinery only. Betts electrolytic process.
IOWA:
Dubuque—*J. W. Watters.*
KANSAS:
Galena—Galena Smelting & Manufacturing Co.
MISSOURI:
Cadet—*Potosi Lead, Barytes & Mercantile Co.*[1]
Carterville—*Serage Bros.*[1]
Desloge—Desloge Consolidated Lead Co.
Granby—Granby Mining & Smelting Co.
Herculaneum—St. Joseph Lead Co.

[1] Not operated for several years.
[2] Subsidiary of United States Smelting, Refining & Mining Co.
[3] Subsidiary of American Smelters Securities Co.
[4] Smelters of secondary materials, but treating some lead ores.
[5] Subsidiary of National Lead Co.

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MISSOURI—Continued.
Joplin—Picher Lead Co.
Mine La Motte—*Mine La Motte Lead & Smelting Co.*[1]
Valle Mines—*Valle Mining Co.*[1]
Webb City—Webb City Smelting & Manufacturing Co. Under construction.
MONTANA:
Cooke—New World Smelter & Mining Co.
East Helena—East Helena plant, American Smelting & Refining Co.
NEBRASKA:
Omaha—Omaha & Grant Smelting Co.[2] Refinery only.
NEVADA:
Nelson—*Santa Barbara Searchlight Mining Co.*
Spruce—*Black Forest Mines & Smelter Co.*
Wells—*Ohio Lead Mining & Smelting Co.*[1]
NEW JERSEY:
Newark—Balbach Smelting & Refining Co. Refinery also.
Perth Amboy—Perth Amboy plant, American Smelting & Refining Co. Refinery also.
Perth Amboy—International Smelting & Refining Co. Refinery only. Under construction.
NEW MEXICO:
Cerrillos—*Consolidated Mining & Smelting Co.*[1]
Deming—*National Mining & Smelting Co.*[1]
Hermosa—El Cliff Mining Co. Partridge hot-blast process. Under construction.
PENNSYLVANIA:
Carnegie—Pennsylvania Smelting Co.
TEXAS:
El Paso—Kansas City Consolidated Smelting & Refining Co.[2]
UTAH:
Midvale—United States Smelting Co.[3]
Murray—Murray plant, American Smelting & Refining Co.
Silver City—*Tintic Smelting Co.*
Tooele—International Smelting & Refining Co. Under construction.
WASHINGTON:
Everett—Everett plant, American Smelters Securities Co.[4] Refinery also.
Kellar—*Kellar & Indiana Consolidated Smelting Co.*[1]
Tacoma—Tacoma Smelting Co.[5]
WISCONSIN:
Dodgeville—*Blue Mounds Mining & Smelting Co.*[1]
Waukesha—*Northern Smelting Co.*[1]

NEW SMELTERS.

The Webb City Smelting & Manufacturing Co. completed a new soft lead smelter at Webb City, Mo., late in 1910. It is equipped with 6 Jumbo Scotch hearths, 2 small circular blast furnaces to reduce the gray slag, 2 drossing kettles, and ample bag-house capacity. The new smelter will use lead ore from the Joplin region, making the fourth smelter in the district to use such ore, the others being the Granby, Galena, and Picher smelters.

The Lemhi Smelting Co. constructed an 80-ton circular lead stack in 1909 and made a short run. Another short run was made in 1910.

The North Fork Smelting & Mining Co. constructed a small lead smelter at Enaville, Idaho, on the western border of the Coeur d'Alene district, and made a few trial runs upon ores from that district.

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[1] Not operated for several years.
[2] Subsidiary of American Smelting & Refining Co.
[3] Subsidiary of United States Smelting, Refining & Mining Co.
[4] Dismantled in 1909–10.
[5] Subsidiary of American Smelters Securities Co.

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The Santa Barbara Searchlight Mining Co. in 1909 erected a small lead furnace near Nelson, Clark County, Nev., and made a trial run. The smelter was not in operation in 1910.

The International Smelting and Refining Co. early in 1911 authorized the construction of 2 lead furnaces in connection with the copper smelter at Tooele, Utah. The furnaces will each have a capacity of 250 tons of ore. A late report has it that an additional furnace has been authorized, making a capacity of 750 tons in all. Construction is well under way and the furnaces will probably be blown in before the close of 1911. The same company has begun the construction of an electrolytic lead refinery in connection with its copper refinery at Raritan, N. J.

ADDITIONS TO CAPACITY.

The Perth Amboy plant of the American Smelting & Refining Co. was increased by the erection of a second blast furnace doubling the smelting capacity. The capacity of the refinery is already much in excess of the smelting capacity.

The United States Metals Refining Co. added to the refinery at Grasselli, Ind., a small bag house for the recovery of antimony and arsenic fumes. The recovery of bismuth was begun, and chemically pure antimony as well as antimonial lead was produced.

The Federal smelter near Alton, Ill., added 2 Dwight & Lloyd sintering machines and a steam drying house capable of thawing and drying several loaded cars of concentrates.

The St. Louis Smelting & Refining Co. added a new blast furnace 36 inches by 126 inches in size and a second Dwight & Lloyd sintering machine. The ore-hearth capacity has been reduced one-half.

The St. Joseph smelter at Herculaneum, Mo., added another furnace 42 inches by 160 inches in size, and a new steel casting room with new drossing furnaces. Additional Dwight & Lloyd sintering machines were installed, making 4 large-size machines now in use at the plant. A new 360-foot stack was erected.

The Picher Lead Co. has doubled its ore-hearth capacity since 1908, with proportionate increase in bag-house capacity. The litharge department was also doubled in 1910. It is authentically reported that a chrome-yellow department will be added.

The Galena Smelting & Manufacturing Co.'s plant at Galena, Kans., was partially wrecked by a tornado in September and suffered serious damage by fire in November. Advantage was taken of the restoration to make needed improvements and additions, among which was the change from steam to electricity as motive power. The plant was put in operation in December.

The Globe plant of the American Smelting & Refining Co. at Denver installed more Huntington-Heberlein roasting pots, erected arsenic furnaces and settling chambers, and began the recovery of arsenic and cadmium. The recovery of cadmium is treated somewhat more in detail in the short chapter on that subject in Part I of Mineral Resources of the United States for 1910, of which this report is also a chapter.

At the Arkansas Valley plant of the American Smelting & Refining Co. at Leadville, the Huntington-Heberlein roasting pots were increased in number as they were also at the Pueblo plant of the same company.

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The Ohio & Colorado Smelting Co. added 3 new Dwight & Lloyd sintering machines to the one already in use, and made other improvements.

The Needles Mining & Smelting Co., a subsidiary of the United States Smelting, Refining & Mining Co., on taking over the property of the Needles Smelting & Refining Co., added a new lead furnace to the smelter at Needles, Cal., increasing the capacity from 150 to 300 tons daily. A 150-ton concentrating mill and a Huff electrostatic separating plant were also erected.

At the East Helena plant of the American Smelting & Refining Co., 2 large-size Dwight & Lloyd machines were added to the smaller machine already installed.[1]

ABANDONED AND DISMANTLED LEAD SMELTERS.

The Kansas City plant of the Kansas City Consolidated Mining & Smelting Co., which is a subsidiary of the American Smelting & Refining Co., has not been operated for a number of years. It was dismantled in 1909. The Eilers plant of the American Smelting & Refining Co. at Pueblo, Colo., and the Everett plant of the American Smelters Securities Co., at Everett, Wash., were closed down and dismantled in 1910.

A number of smelters which have not been operated for several years and which possibly have been abandoned are indicated in the foregoing lists of smelters.

METALLURGICAL ADVANCE.

Various new processes for smelting the mixed sulphides of lead and zinc, first recovering the zinc and then treating the lead residues in the ordinary way, have been described in the chapter on zinc in this volume. Outside of these processes, the chief metallurgical advances in the treatment of lead in 1910 have been in the increased employment of mechanical appliances for the blast roasting of sulphide ores and in the development of processes for the amelioration of smelter-smoke problems.

ROASTING DEVICES.

As noted in the preceding pages the capacity of plants using the Huntington-Heberlein process of blast roasting has been largely increased. Similarly a great increase in the number of Dwight & Lloyd sintering machines is recorded. The first Dwight & Lloyd machine to be used in the United States for roasting and sintering lead ore was installed at the Perth Amboy plant of the American Smelting & Refining Co., and was of the revolving-drum type. This type was succeeded by the straight-line machine, an endless chain of pallets carried upon two drums. Another type is the horizontal circular table machine. The straight-line pallet machine is the one which has generally been used in lead-ore roasting in this country. In addition to the installation of these machines in 1910, as noted in the preceding pages, they have also been installed by the Tacoma Smelting Co. and the Selby Smelting & Lead Co.[2] There are in use

[1] Austin, L. S., Min. and Sci. Press, Jan. 28, 1911, p. 177.
[2] Hofman, H. O., Eng. and Min. Jour., Jan. 7, 1911, p. 50.

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two sizes of the machines, having 50 and 100 tons capacity, respectively. The former has a suction-blast area of 30 by 150 inches and the latter of 42 by 264 inches. The properly mixed charge is spread upon an endless chain of herringbone grated pallets which first pass under the ignition box, where the roasting is started, and then across the suction area, where the main roasting and sintering is accomplished. The roasting and sintering action continues while the pallet is passing between the suction area and the end drum of the machine. Here the pallets fall approximately one-fourth the circumference of the drum, and the shock loosens the sinter from the pallet and drops it into the waiting car. The blast roasting and sintering processes have all materially increased the smelting capacity of the blast furnaces where they have been introduced.

THE SMELTER SMOKE PROBLEM.

The smelter-smoke problem has two phases: First, the removal of suspended solid particles, that is, the condensation of the fume; and, second, the elimination of SO_2 and SO_3, sulphur gases. The escape of arsenic, lead, and antimony in smelter fumes not only involves a loss of values, but introduces poisonous elements into the air. Sulphur dioxide, SO_2, is permissible in escaping fumes to the extent of three-fourths of 1 per cent according to the decision of the courts in the Salt Lake City smelter cases. Sulphuric acid gas, SO_3, combines with moisture to form sulphuric acid, which if present in rain in more than 40 parts per 1,000,000 is injurious to vegetation and to stock feeding upon the vegetation.

The copper smelters have generally depended upon long flues with large settling chambers for fume precipitation and upon high smoke-stacks for gas dissipation. The Boston & Montana copper smelter at Great Falls, Mont., has lately been equipped with a stack 506 feet in height and 50 feet in diameter at the top, the largest stack in the world. The dust chamber, 176 feet wide by 478 feet long and 21 feet high, is equipped with the Roesing system of suspended iron wires. These are hung 4 inches apart each way, and there is a device for shaking them to dislodge the dust. This is the first installation of the system in this country, and it is said to be working successfully. It is applicable to lead smelters also. The gas discharged from high stacks is usually diluted sufficiently to be harmless before reaching the ground, but in particular cases of peculiar topographic conditions or prevailing winds the gases may drift bodily for miles without becoming materially weakened. The Wislicenus plan proposes to perforate the upper part of the stack with a system of funnel-shaped horizontal apertures through which the wind blows, diffusing and diluting the body of gases.

Many lead smelters, in addition to settling chambers and high stacks, filter the fumes through bags. Roaster gases contain so much sulphuric acid that they destroy the cloth bags unless the fumes are previously neutralized. The Fiechter asbestic-thread bags, in use in Europe, are not affected by the sulphuric acid. At the United States Smelting Co.'s smelter at Midvale, Utah, the Sprague process of neutralizing the sulphur gases with zinc oxide and lime is used. In a brick furnace connected with the pot roaster flues, a fire of slack coal is maintained over a layer of limestone to which a small proportion of zinc ore has been added. The zinc is oxidized and the limestone

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burned, and these escaping into the flues change the SO_2 to zinc sulphate and calcium sulphate. The process is completely successful. The conversion of the sulphur gases into sulphuric acid is not practicable for most smelters, situated, as they usually are, far from markets for that commodity. Moreover, the demand for sulphuric acid in the United States would utilize only a small fraction of the quantity which could be made by this process.

The Selby Smelting & Lead Co. installed at the plant at Selby, Cal., an experimental unit of the Cottrell system of electric precipitation of smelter fume by electric discharges of high potential. This was to treat the roaster and refinery gases, as the blast-furnace fumes are filtered through bags. The installation was successful in removing sulphuric acid and solid particles from the fumes. Further installation depends upon the attitude of the local courts toward the disposition of the sulphur dioxide gas.

SPECIAL PROCESSES.

A number of recently invented processes combining concentration and chemical methods and the ordinary means of roasting and smelting for the reduction of complex ores are in various stages of demonstration. Some of these will be briefly noticed.

The Malm process will be operated by the Western Metals Co. in a 100-ton plant nearing completion at Georgetown, Colo. The process involves chlorination, precipitation of the metals, except zinc, and electrolysis of the zinc chloride. A fuller description of the process is given in the chapter on zinc in this volume.

The Rankin process consists in treating the sulphides with nitric acid, thus oxidizing them to sulphates, the acid fumes being recovered as nitric acid. The metals in solution as sulphates are then recovered by suitable chemical or electrochemical means. A commercial plant employing the method is under construction at Lake City, Colo.

The Motter method is being tested by the Colorado Metals Extraction Co. in a 20-ton plant at Denver, Colo. The process involves a sulphatizing roast in a cylinder furnace, the temperature and air under such control that the sulphides of the metals except zinc are changed to sulphates. The iron, copper, and other sulphates are leached out leaving lead sulphate and zinc sulphide, which are concentrated and separated in the ordinary way. The copper in solution is recovered by electrolysis and the sulphate of iron is evaporated to crystalline form—that is, copperas.

The Dawson method subjects the pulverized ore to a temperature of 1,400° to 1,500° F. in a slowly revolving magnesite-lined drum. When the charge is heated to the required temperature, the blast is withdrawn; 20 pounds of charcoal to the ton of charge is thrown in; and the drum is made air-tight. After a few more revolutions the charge is withdrawn and the metals are found to be reduced, although the gangue is not fused. The metallic particles can now be separated perfectly from the gangue by ordinary means of concentration. The usual procedure of concentration before smelting is thus reversed. The demonstration plant at El Paso, Tex., has a capacity of 50 tons per 10 hours.

The Partridge furnace of the usual design is a small blast furnace designed for location near the mine. In this furnace the blast is pre-

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heated by the slag which is continuously discharged upon an endless chain of small overlapping pans. These travel through a brick tunnel through which the blast also is drawn, thus raising it to a high temperature. The furnaces are thus susceptible of very economical operation and they are reported to yield good recovery in practice.

Frank C. Mathers has patented (U. S. No. 931944) the use of a solution of lead perchlorate for the electrolytic refining of base bullion. Various addition reagents, preferably peptone, favor the density and noncrystalline character of the deposit. Among the advantages claimed for the solution are stability, great solubility, and high electrical conductivity.

TRADE CONDITIONS.

WORLD'S PRODUCTION.

The following table of the production of lead in the world has been calculated from the statistics published by the Metallgesellschaft, of Frankfurt-am-Main, Germany, with the exception of the substitution of the figures collected by the United States Geological Survey for the production of the United States. It is to be noted that the production of Africa and South America is not separately given in the table. As shown on a preceding page, considerable lead has been smelted and refined in the United States in the last four years from ores produced in those countries.

The world's production of lead, 1904–1910, in short tons.

Country.	1904	1905	1906	1907	1908	1909	1910
Australia	131,615	117,946	102,514	106,923	131,174	85,098	108,907
Austria-Hungary	14,440	14,881	18,078	16,975	16,094	15,432	19,290
Belgium	25,904	25,243	24,471	28,417	39,352	44,423	43,651
Canada	18,960	28,329	26,235	23,778	21,605	22,928	16,535
France	20,723	26,565	28,219	25,353	28,770	29,652	23,148
Germany	151,676	168,211	166,117	157,156	180,887	185,076	174,053
Great Britain	26,896	25,684	26,455	30,203	32,738	31,085	33,620
Greece	16,755	15,102	13,338	15,212	17,637	16,865	18,519
Italy	25,904	21,054	23,479	25,243	28,660	24,361	17,639
Japan	1,984	2,535	3,858	3,858	3,197	3,748	3,858
Mexico	92,483	82,673	59,524	79,366	121,253	130,071	138,890
Russia	331	331	331	110	110	882	1,328
Spain	195,989	199,186	199,406	204,848	202,052	202,823	211,201
Sweden	661	661	882	882	331	220	331
Turkey in Asia	11,795	11,464	10,582	11,464	13,007	13,338	13,999
Other countries	331	220	220	220	551	4,519	14,220
United States (domestic)	307,000	302,000	350,153	365,166	310,762	354,188	372,227
Total	1,043,447	1,042,085	1,053,862	1,095,174	1,148,180	1,164,709	1,211,411
United States percentage of world's production	29.5	29.0	33.2	33.3	27.1	30.4	30.7

Australia made a good gain in production, nearly making up the loss suffered on account of industrial troubles in 1909. The Canadian lead output was considerably reduced owing to the destruction of many mine buildings, concentrating plants, and railway communications by forest fires in British Columbia in the latter part of the year. There was also reduced lead production in France, Germany, and Italy, but Austria, Great Britain, Greece, Mexico, and Spain showed good gains. In point of production the United States was first, with 30.7 per cent of the total output; Spain was second, with 17.4 per cent; Germany third, with 14.4 per cent; Mexico fourth, with 11.5 per cent; and Australia fifth, with 9 per cent of the total. These five countries produced 83 per cent of the total lead production in 1910.

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IMPORTS AND EXPORTS.

WAREHOUSE TRANSACTIONS.

Lead imported into the United States as metal or in ore may be entered for immediate consumption, in which case the duty is paid and the lead goes direct to the consumer; or it may be entered for warehouse, bond being given for double the amount of the estimated duty. From warehouse the lead may be withdrawn for consumption by payment of duty, or it may remain in bond for smelting and refining, finally being either withdrawn for consumption or exported from warehouse with cancellation of bond. The lead entered for immediate consumption and that withdrawn from warehouse for consumption make up the table below of imports for consumption which are expressed in the same terms as those in which they were imported. The lead imported for consumption may be actually used in this country, or it may be manufactured into articles which are exported, in which case the manufacturer is entitled to the benefit of a drawback of 99 per cent of the duties paid. In the table below, showing foreign lead exported in manufactures with benefit of drawback, the lead is shown in the form in which it was originally imported. On account of diversity of form it is not feasible to show the articles exported with benefit of drawback. The foreign lead given in the table below as exported from warehouse is likewise shown in the form in which it was imported and entered for warehouse.

The two items, foreign lead exported from warehouse and foreign lead exported in manufactures with benefit of drawback, make up the total foreign lead going out of the country. Lead in warehouse and deductions by liquidation being disregarded, the difference between the sum of these two exports of lead and the total imports of lead constitutes the foreign lead consumed in this country. For the sake of simplicity this foreign lead is carried on the bonded customs warehouse records in the form in which the lead was entered until the bond is canceled. It must be clearly understood, therefore, that in the table of foreign exports of lead, on a later page, the lead there listed was not exported as lead content of ore and base bullion but as refined lead smelted and refined from them. There is no record kept of the lead in the form in which it is actually exported except for a portion of the articles manufactured from foreign lead and exported with benefit of drawback. For articles not made wholly of lead it would be useless to give weights. But each shipment on which drawback is claimed is accompanied by a manifest of the imported lead used in making the articles and the duty paid thereon. From these manifests is derived the statement of the total quantity of foreign lead used in manufactures exported with the benefit of drawback. For this reason the lead is given in the form in which it was imported.

The following table, taken from the reports of the Bureau of Statistics, shows the lead remaining in warehouse at the close of each year, beginning with 1899, and also the district in which remaining. For the reasons given above, the lead is shown in the terms in which imported. For instance, a considerable part of the lead stated as remaining in ore and base bullion doubtless represents refined lead waiting at the bonded refinery for a favorable market for shipment. If this be borne in mind, the table gives a fair idea of the fluctuations of foreign stock at different times and in different localities.

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Lead remaining in warehouse, 1899–1910, in pounds.

December 31—	Form in which entered for warehouse.		Remaining at a—					
	Lead in ore and base bullion.	Pigs, bars, and old.	Newark, N. J.	Perth Amboy, N. J.	Chicago, Ill.	El Paso, Tex.	San Francisco, Cal.	Puget Sound.
1899	22,302,286	17,033	6,343,323	12,070,835	215,032	2,552,911	122,851	976,012
1900	42,379,270	.....	10,692,307	10,157,018	2,236,555	2,642,568	3,149,975	6,147,500
1901	33,225,677	18,808	5,927,080	7,964,931	.....	1,325,874	2,521,095	6,122,420
1902	47,817,806	59,487	8,198,289	14,176,702	4,157,558	2,949,481	3,745,809	2,073,152
1903	21,387,901	.....	5,192,823	3,850,638	3,896,471	4,079,021	3,430,528	938,422
1904	22,962,984	.....	1,629,852	7,482,560	5,999,972	6,062,072	1,732,742	46,295
1905	16,296,391	112	10,117	6,746,035	3,755,890	4,533,951	260,777	941,623
1906	11,382,998	128,812	1,743,853	3,870,951	2,736,979	229,267	306,607	2,490,817
1907	25,794,409	93,286	1,067,836	6,197,503	7,918,991	8,846,533	1,226,361	.....
1908	36,923,604	206,651	6,772,049	23,356,695	3,950,517	2,381,867	15,526	.....
1909	34,655,780	158,208	4,941,828	18,213,808	9,461,123	1,832,867	39,911	.....
1910	71,794,443	149,082	7,548,936	36,112,136	21,090,631	6,937,667	.....	.....

a Also in 1900 at Kansas City, Mo., 1,776,137 pounds, and at Omaha, Nebr., 5,306,351 pounds; in 1901, at Denver, Colo., 9,364,318 pounds; and in 1902, at Denver, Colo., 12,516,815 pounds.

IMPORTS.

The following tables of lead and type metal imported and entered for consumption and of general imports of lead are taken from the reports and records of the Bureau of Statistics:

Lead imported and entered for consumption in the United States, 1900–1910, in pounds.

Year.	Lead in ore.a		Base bullion.b		Pigs, bars, and old.		Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1900	10,209,742	$623,802	.....	.....	3,673,616	$76,141	27,945	$1,393	$877	$702,213
1901	10,324,119	272,396	.....	.....	3,604,157	88,056	56,735	2,773	1,234	364,459
1902	14,499,339	316,005	.....	.....	12,443,615	319,035	224,209	7,765	5,258	648,063
1903	41,155,130	716,128	.....	.....	8,972,635	255,135	17,008	810	1,589	973,662
1904	19,015,540	328,279	.....	.....	17,334,033	480,823	69,581	2,441	5,277	816,820
1905	49,526,990	784,548	.....	.....	10,379,753	329,209	77,668	3,813	1,139	1,118,709
1906	44,560,258	755,545	587,731	$15,635	24,882,983	960,998	346,177	17,250	4,503	1,753,931
1907	13,363,875	286,802	1,196,224	35,303	15,667,170	718,198	734,418	39,210	3,450	1,082,944
1908	2,806,524	76,746	11,415,463	251,266	5,346,290	176,363	42,377	2,026	9,843	516,244
1909	7,080,753	142,847	21,896,611	454,568	7,095,442	229,751	40,434	2,056	32,284	861,506
1910	7,998,859	198,196	16,543,167	337,223	6,776,066	212,858	39,779	1,972	4,843	755,092

a For period 1900–1905, inclusive, the gross weight and value of base bullion imported for consumption are also included.

b For the years previous to 1906 the imports of base bullion (gross weight) are not distinguished from imports of lead in ore.

Type metal imported and entered for consumption, 1899–1910, in pounds.

Year.	Type metal.		Lead content.a	
	Gross weight.	Value.	Pounds.	Percentage.
1899	1,110,188	$56,442	.....	.....
1900	1,032,866	51,242	.....	.....
1901	3,222,431	116,375	.....	.....
1902	6,469,971	194,394	.....	.....
1903	6,603,863	208,728	.....	.....
1904	8,143,749	221,127	6,884,423	84.5
1905	13,932,013	456,155	11,476,629	82.4
1906	19,602,471	900,608	15,896,629	81.1
1907	14,832,673	932,027	12,095,027	81.5
1908	4,110,496	156,847	3,265,815	79.5
1909	13,993,889	532,108	11,339,378	81.0
1910	13,394,199	485,493	11,176,830	84.9

a Prior to 1904 the lead content of the type metal was not given. Besides lead, the chief constituent of the type metal is antimony.

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Imports of lead, in ore, base bullion, and refined, by countries, 1905–1910, in pounds.

Country.	1905	1906	1907	1908	1909	1910
United Kingdom	1,589,859	9,852,760	433,971	399,569	191,243	1,874,750
Germany	250,241	2,006,369	456,649	696,151	2,821,967	421,377
Other European countries	117,699	3,920,313	6,922,276	1,699,509	1,385,616	418,669
Total from Europe	1,957,799	15,779,442	7,812,896	2,794,229	4,398,826	2,714,796
British North America	16,362,916	18,514,244	13,272,900	1,291,044	4,133,755	206,979
Mexico	175,167,694	133,512,526	137,543,692	219,567,193	215,203,714	203,290,307
South America	3,154,483	315,265	883,355	469,770	1,942,847	6,598,263
Other countries	112,516	147,462	117,138	26,418	2,683,950	4,394,421
Total imports	196,755,408	168,268,939	159,629,981	224,148,654	228,363,092	217,204,766

In the foregoing table the lead imports in 1910 from Europe consisted almost wholly of lead in ore. Of the lead imported from Mexico, 81,586,830 pounds was in ore, 115,482,542 pounds was contained in the base bullion, constituting the whole imports of base bullion into the United States, and 6,220,053 pounds was in the form of refined lead. From Chile there was imported 6,594,334 pounds of lead in lead ore and from German East Africa 4,394,421 pounds in lead ore.

The following table shows the imports of lead in ore, base bullion, and pigs, bars, sheets, and old for the years 1907–1910:

Imports of lead, by classes, 1907–1910, in pounds.

Year.	Lead in ore (lead content).	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.a
		Gross weight.	Lead content.a		
1907	64,815,254	76,259,828	74,594,313	18,554,899	157,964,466
1908	64,708,204	153,921,829	150,560,176	5,518,621	220,787,001
1909	71,357,868	149,852,559	146,579,779	7,152,665	225,090,312
1910	94,751,054	118,061,415	115,483,542	6,970,170	217,204,766

a Lead content of bullion for 1907–1909 estimated on the basis of average lead content of imports of base bullion in 1910.

EXPORTS.

DOMESTIC EXPORTS.

The average difference between the New York and the London lead prices for the last 10 years has been not far from 1½ cents per pound. This being the case, domestic lead exports should be expected only under temporary and very unusual circumstances. The practice of the Bureau of Statistics is to class all exports of lead articles manufactured in this country as domestic exports whether the lead be of domestic or foreign origin. The table of exported lead and manufactures of lead of domestic production, made up from the records of the Bureau of Statistics, and heretofore published in this report, must be duplicated in part if not completely in the following table of exports of manufactures with benefit of drawback. For this reason it has been decided to abandon the table of domestic exports, as previously published.

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FOREIGN EXPORTS.

By foreign lead exports is meant the exports of lead of foreign origin which has been smelted, refined, or manufactured in this country and then shipped abroad. The following table, made up from the records of the Bureau of Statistics, shows the total lead exported for a period of years, but it must be borne in mind, as pointed out on a previous page, that the actual exports were not in the form shown in the table which is the import form, but instead consisted of refined lead and lead manufactures. The quantities of lead exported from warehouse are exact, but the quantities given of lead in manufactures are subject to the waste in manufacturing.

Under the present tariff regulation the lead that must be sent out before the bond can be canceled is that actually recovered in smelting and refining the ore and base bullion. Under the preceding tariff the bond was canceled when 90 per cent of the lead content of the ore or gross weight of the base bullion was shipped out. If then, in refining base bullion, more than 90 per cent of the total weight was recovered as lead, the bond would be canceled on the exportation of that 90 per cent and the excess above 90 per cent could remain in this country without payment of duty. No doubt in past years considerable foreign lead used in this country has escaped duty in this wise.

Exports of foreign lead, 1900–1910, in pounds.

Year.	Exported from warehouse.							Exported in manufactures with benefit of drawback.	
	Lead content ore.[a]		Lead content base bullion.[a]		Pigs, bars, and old.		All other manufactures.	Lead content ore.	Pigs, bars, bullion, and old.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	Quantity.	Quantity.
1900..	197,795,960	$3,840,798	.....	.....	30,163	$564	$2,519	1,705,970	6,861,030
1901..	194,724,197	4,183,101	.....	.....	50,000	2,500	4,924	9,452,628	5,935,331
1902..	157,891,135	3,551,380	.....	.....	43,130	1,000	764	2,173,559	9,501,049
1903..	163,774,605	2,908,531	.....	.....	55,566	1,627	7,799	2,339,106	9,331,256
1904..	167,686,199	2,844,403	.....	.....	87,471	3,937	32,467	2,946,810	10,445,974
1905..	117,263,861	2,378,327	.....	.....	1,647,523	54,993	7,846	3,584,610	12,700,971
1906..	94,449,751	2,303,382	.....	.....	48,680	1,138	2,825	3,447,478	8,536,424
1907..	102,847,310	2,416,082	.....	.....	47,078	2,169	3,033	1,826,756	14,709,149
1908..	153,657,371	3,068,427	.....	.....	56,000	1,500	32,026	9,392,428	9,114,209
1909..	118,325,560	2,002,644	[b] 53,817,393	$1,036,080	11,447	487	697	2,992,967	6,598,149
1910..	22,508,090	248,220	117,045,333	2,262,057	19,507	703	870	6,592,294	11,008,604

[a] Prior to June, 1909, exports of foreign lead from warehouse do not distinguish between lead content of ore and gross weight of base bullion.
[b] For six months, July–December, 1909.

CUSTOMS DUTIES.

The Payne-Aldrich tariff of 1909, effective August 6, 1909, made a reduction of ⅛ cent per pound in the duty on lead pipe, sheets, shot, wire, etc., and an important change in the section regulating the smelting and refining of lead in bond. The sections of the new tariff which are concerned with lead and lead products are as follows:

181. Lead-bearing ore of all kinds, one and one-half cents per pound on the lead contained therein: *Provided*, That on all importations of lead-bearing ores the duties shall be estimated at the port of entry, and a bond given in double the amount of

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such estimated duties for the transportation of the ores by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the samples thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon, except in case of ores that shall be removed to a bonded warehouse to be refined for exportation as provided by law. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

182. Lead dross, lead bullion or base bullion, lead in pigs and bars, lead in any form not specially provided for in this section, old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured; all the foregoing, two and one-eighth cents per pound; lead in sheets, pipe, shot, glaziers' lead and lead wire, two and three-eighths cents per pound.

191. Type metal, one and one-half cents per pound on the lead contained therein.

49. Red lead, two and five-eighths cents per pound.

53. White lead, and white pigment containing lead, dry or in pulp, or ground or mixed with oil, two and one-half cents per pound.

58. Lead: Acetate of, white, three cents per pound; brown, gray, or yellow, two cents per pound; nitrate of, two and one-fourth cents per pound; litharge, two and one-half cents per pound.

Sec. 24. That the works of manufacturers engaged in smelting or refining, or both, of ores and crude metals, may upon the giving of satisfactory bonds be designated as bonded smelting warehouses. Ores or crude metals may be removed from the vessel or other vehicle in which imported, or from a bonded warehouse, into a bonded smelting warehouse without the payment of duties thereon and there smelted or refined, or both, together with other ores or crude metals of home or foreign production: *Provided*, That the several charges against such bonds may be canceled upon the exportation or delivery to a bonded manufacturing warehouse, established under section twenty-three of this act, of the actual amount of lead produced from the smelting or refining, or both, of such ores or crude metals: *And provided further*, That said lead may be withdrawn for domestic consumption or transferred to a bonded customs warehouse and withdrawn therefrom upon the payment of the duties chargeable against it in that condition: *Provided further*, That all labor performed and services rendered pursuant to this section shall be under the supervision of an officer of the customs, to be appointed by the Secretary of the Treasury, and at the expense of the manufacturer: *Provided further*, That all regulations for the carrying out of this section shall be prescribed by the Secretary of the Treasury.

Under the tariff of 1897 the customs bond was canceled upon the exportation of 90 per cent of the weight of base bullion or lead contents of ore imported. Under the present tariff the bond is canceled only upon the exportation of the actual quantity of lead produced from the base bullion and ore. This change made it compulsory upon the Treasury Department to ascertain the exact recovery and wastage of lead. Prof. H. O. Hofman, of the Massachusetts Institute of Technology, was employed to investigate the wastage in both smelting and refining at the various bonded smelters. His report, being confidential, has not been given out by the Treasury Department. The following, taken from the Engineering and Mining Journal of June 17, 1911, purports to give the general results of the investigation:

It appears that Prof. Hofman in his investigations at the various bonded smelting warehouses found that there was a wide divergence in the amount of waste at the various places owing to the different character of the ores. He, therefore, recommended the establishment of the actual wastage at each plant as determined from a scrutiny of the records for three years back. * * * Prof. Hofman's reports showed that the wastage in smelting varied from 5 or 6 per cent at some plants to over 20 at others. There was also a wide variation of the loss incurred in refining base bullion, the figure running as low as less than 1 per cent in some cases, while in others it was

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very greatly in excess of that. Probably the most refractory ores studied by Prof. Hofman were those which were smelted at Perth Amboy, N. J. These are the Canadian ores and the difficulty with them is due to the presence of large quantities of arsenates. Some plants have stopped smelting these ores on account of the high percentage of waste connected with them.

The Consolidated Kansas City Smelting & Refining Co. having protested the assessment of duty at El Paso upon both lead and zinc contents of an ore carrying more than 10 per cent of zinc, which zinc was alleged to be lost in smelting, the Board of United States General Appraisers on June 27, 1910, affirmed (T. D. 30727) the imposition of duty upon both lead and zinc contents under the provision of paragraphs 181 and 193 of the tariff of 1909. The plaintiff having carried the case to the United States Court of Customs Appeals, that body overruled the importers' claim (T. D. 31509) and sustained the action of the collector.

The American Smelting & Refining Co. protested the assessment of a duty of 2½ cents per pound upon antimonial lead withdrawn from the bonded smelting warehouse at Perth Amboy. It was claimed that the by-product, antimonial lead, is of the composition of type metal, that it was withdrawn for use as type metal, and that it should be dutiable at the rate of type metal—that is, 1½ cents per pound upon the lead contents thereof, as provided in paragraph 191 of the tariff of 1909. It was also urged that the same results could be secured by withdrawing the antimonial lead from bond for export and thereafter reimporting it as type metal. The United States Board of Appraisers (T. D. 31201) affirmed the assessment of duty and overruled the protest.

In this connection it may be remarked that an inspection of the table of imports of type metal as given on a preceding page shows that metal to be essentially antimonial lead in composition.

CONSUMPTION.

In statements of lead consumption in these reports prior to 1907 it was the custom to take into account the smelter stocks of lead at the beginning and at the close of the year. It is not to be denied that for the individual year this gives closer figures. It is just as true that account of trade stocks should also be taken to arrive at accurate results; but this is manifestly outside the scope of this bureau. It has been found impossible to obtain a statement of stocks from one large producer since 1906; hence consumption has been calculated without reference to domestic stocks. A very considerable part, however, amounting to between one-fourth and one-fifth of the lead smelted and refined in this country, is lead of foreign origin smelted in bond, and it is possible to obtain the stocks of this portion, since they are reported annually by the Bureau of Statistics as "merchandise remaining in warehouse at close of year." A certain element of error is introduced by the fact that the imports, the exports, and the warehouse stocks, as given, include lead in both ore and base bullion. So far as imports are concerned, the relative quantities of lead in ore and of base bullion are shown in the table on a preceding page, entitled "Imports of lead, by classes," based upon the records of the Bureau of Statistics, and corroborated in the preceding table giving the "sources of primary lead smelted or refined in the United

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States," based upon smelter reports. For exports and warehouse stocks no such division can be made, because the classes used therein represent the condition of the metal when imported, and do not change with the reduction of the metal in bond. Nevertheless, it is deemed advisable to use warehouse stocks as giving a better estimate of consumption. It is necessary, therefore, to include all classes of lead imports as well as all classes of lead exports.

In the following table "lead" includes all kinds—lead in ore, base bullion, pigs, bars, and old. The figures of domestic production are based upon the returns by the smelters; all other figures are from the records of the Bureau of Statistics. Decrease by liquidation covers losses in smelting and refining in bond and other corrections. Because warehouse stocks are used in lieu of smelter stocks the result given below is lead "available for consumption." The "apparent consumption" of previous reports would be this quantity increased or diminished by the increase or decrease of domestic stocks during the year.

Consumption of primary lead in the United States, 1907–1910, in short tons.

	1907	1908	1909	1910
Supply:				
Stock in bonded warehouses Jan. 1	5,756	12,944	18,565	17,405
Imports—				
For consumption	15,246	9,805	18,036	15,359
For warehouse	64,569	102,241	96,145	93,249
Production from domestic ores	365,166	310,762	354,188	372,227
Total supply	450,737	435,752	486,934	498,240
Withdrawn:				
Exports of foreign lead—				
From warehouse	51,447	76,857	86,077	69,786
In manufactures, with benefit of drawback	8,268	9,254	4,796	8,800
Decrease by liquidation	4,578	13,425	8,643	7,661
Stock in bonded warehouses Dec. 31	12,944	18,565	17,405	35,972
Total withdrawn	77,237	118,101	116,921	122,219
Available for consumption	373,500	317,651	370,013	376,021

For facility of comparison of consumption in the United States with that of the world, the consumption of the former has been calculated with and without stocks for a period of years, as shown in the following table. Consumption of lead, as shown in the second column, means the production of refined lead minus excess of exports over imports or plus excess of imports over exports. Additions made to stock during the year will thus appear as consumed, but as such stocks are apt to go into the market within the next year and cut down the apparent consumption to that extent, they must compensate in the long run, leaving an accurate average measure of the consumption. The statistics of consumption of foreign countries as given in the table are taken from the estimates of the Metallgesellschaft, etc., which are also compiled without regard to stocks. In the following table, the first column gives, for the sake of comparison, the consumption with stocks taken into consideration; the remainder of the table disregards stocks. In neither column showing the United States consumption is the production of secondary lead taken into account.

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World's consumption of pig lead, exclusive of secondary lead, 1898–1910, in short tons.

Year.	Stocks considered.	Stocks disregarded.			
	United States.	United States.	Foreign countries.	Total world's consumption.	United States, percentage.
1898	227,452	225,177	651,018	876,195	25.7
1899	226,315	230,294	652,782	883,076	26.1
1900	269,302	279,172	667,002	946,174	29.5
1901	271,934	284,126	663,805	947,931	29.9
1902	332,484	300,643	685,079	985,722	30.5
1903	300,167	284,556	701,945	986,501	28.8
1904	319,543	320,330	719,471	1,039,801	30.8
1905	347,015	343,682	736,998	1,080,680	31.8
1906	376,337	376,981	705,142	1,082,123	34.8
1907	[a] 373,500	386,711	708,559	1,095,270	35.3
1908	[a] 317,651	336,292	828,043	1,164,335	28.9
1909	[a] 370,013	368,853	808,755	1,177,608	31.3
1910	376,021	394,588	802,254	1,196,842	33.0

[a] See preceding table, "Consumption of primary lead in the United States" in 1907–1910.

Consumption of lead, stocks and secondary lead disregarded, in 1906–1910, by countries, in short tons.

Country.	1906	1907	1908	1909	1910
Australia	4,960	5,952	8,501	5,401	7,937
Austria-Hungary	26,235	27,778	31,906	34,171	34,723
Belgium	26,786	34,723	28,880	48,060	34,061
Canada	17,416	15,983	15,542	17,416	20,944
France	94,688	89,397	114,749	112,765	99,868
Germany	214,838	206,130	233,275	235,010	229,719
Great Britain	213,956	214,287	252,595	223,436	230,711
Holland	5,512	5,732	5,961	6,504	7,165
Italy	33,400	33,290	40,296	34,612	32,738
Japan	15,983	15,983	8,832	12,566	12,676
Russia	27,558	27,668	49,349	42,328	53,792
Switzerland	5,842	5,842	6,514	5,842	6,504
Other European countries	3,307	3,417	4,416	4,409	3,858
Other countries	14,661	22,377	27,227	26,235	27,558
United States	376,981	386,711	336,292	368,853	394,588
Total	1,082,123	1,095,270	1,164,335	1,177,608	1,196,842

USE OF LEAD IN THE UNITED STATES.

The United States Geological Survey does not collect statistics of the use of lead. The following table is from figures published in the Engineering and Mining Journal, which purport to cover about 90 per cent of the total consumption. The figures for 1910 are not available.

Use of lead in the United States, 1907–1909.

	1907		1908		1909	
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.
	Short tons.		*Short tons.*		*Short tons.*	
White lead and oxides	115,000	34.8	117,500	40.5	134,138	38.0
Pipe	41,000	12.4	33,800	11.6	52,914	15.2
Sheets	21,500	6.5	16,400	5.7	23,421	6.7
Shot	28,000	8.5	31,600	10.9	36,433	10.4
Other purposes	125,238	37.8	90,700	31.3	104,094	29.7
Total	330,738	100.0	290,000	100.0	351,000	100.0

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PRICES AND VALUE.

PRICES.

The year opened with lead selling at 4.7 cents per pound in New York, at which figure it remained through January. The price broke early in February, and in sympathy with the London market declined by easy stages to 4.25 cents per pound in May. After this there was a gradual rise until 4.4 cents per pound was attained in July, at which point the price remained stationary until the middle of November, when a sharp rise brought the price to 4.5 cents per pound, which figure prevailed until the close of the year. The average price per pound for the year was 4.4 cents, as compared with an average of 4.3 cents per pound in 1909 and 4.2 cents in 1908. These are the figures used in calculating the value of the lead production of the United States for those years.

In the London market the feature of the year was the culmination, about the middle of January, of the advance which began in the latter part of 1909 and was due in part to Australian labor troubles and in part to anticipation of higher prices as a result of the Lead Convention. This resulted in the high figure of the year, £13 17s. 6d. per long ton (3 cents per pound). Uncertainty as to the plans of the Convention and as to its renewal brought about a decline until the lowest price of the year, £12 6s. 3d. per long ton (2.66 cents per pound) was reached the first week in May. After a slight recovery the price remained nearly stationary until October, when there was a small advance. From that time until the end of the year there was little change, lead closing at £13 2s. 6d. per long ton (2.84 cents per pound). The average London price of lead for the year was £12 19s. per long ton (2.8 cents per pound).

In the following table are shown the highest and the lowest prices of lead at New York in each month during the last 10 years. All figures for prices are in cents per pound. Those for 1906 and later are based upon daily quotations published in the Engineering and Mining Journal and those for preceding years on quotations published in the Iron Age:

Highest and lowest prices of lead at New York City, monthly, 1901–1910, in cents per pound.

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½
1902	4.10	4.00	4.10	4.05	4.10	4.05	4.10	4.05
1903	4.10	4.05	4.10	4.05	4.65	4.10	4.65	4.35
1904	4.50	4.25	4.50	4.40	4.60	4.50	4.60	4.50
1905	4.60	4.45	4.50	4.45	4.50	4.45	4.55	4.50
1906	5.60	5.60	5.60	5.35	5.35	5.35	5.50	5.35
1907	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1908	3.80	3.55	3.75	3.70	4.00	3.65	4.10	3.90
1909	4.22½	4.12½	4.15	3.92½	4.10	3.92½	4.25	4.10
1910	4.70	4.70	4.70	4.52½	4.60	4.35	4.40	4.35

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Highest and lowest prices of lead at New York City, monthly, 1901–1910, in cents per pound—Continued.

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05
1903	4.35	4.30	4.35	4.10	4.10	4.05	4.10	4.05
1904	4.50	4.25	4.35	4.20	4.30	4.10	4.20	4.10
1905	4.55	4.50	4.55	4.50	4.60	4.50	4.85	4.60
1906	5.75	5.50	5.75	5.75	5.75	5.75	5.75	5.75
1907	6.00	6.00	6.00	5.75	5.75	5.25	5.25	5.25
1908	4.37½	4.05	4.52½	4.32½	4.52½	4.40	4.62½	4.47½
1909	4.35	4.20	4.35	4.35	4.35	4.30	4.42½	4.27½
1910	4.37½	4.25	4.40	4.30	4.45	4.35	4.40	4.40

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.00
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05
1903	4.40	4.10	4.40	4.35	4.40	4.10	4.25	4.10
1904	4.25	4.20	4.30	4.20	4.50	4.20	4.65	4.60
1905	4.90	4.85	5.30	4.85	5.40	5.15	5.90	5.25
1906	5.75	5.75	5.75	5.75	5.75	5.75	6.00	5.75
1907	5.25	4.75	4.75	4.75	4.75	4.00	4.10	3.35
1908	4.60	4.52½	4.47½	4.20	4.40	4.25	4.30	4.12½
1909	4.40	4.32½	4.37½	4.32½	4.40	4.32½	4.70	4.37½
1910	4.40	4.40	4.40	4.40	4.50	4.40	4.50	4.50

PRICE CURVES.

The fluctuations in the price of lead at New York and London are graphically shown in figures 2 and 3, which give curves of the weekly average price of lead in those markets for the years 1907–1910, inclusive. The independence of the New York market, except beyond the limit set by the tariff differential, is manifest, as is also the striking artificiality of that market.

1907

In the United States the year opened with large stocks in the hands of consumers, particularly in the electrical and plumbing trades. With the oncoming of the business depression consumers began to use up their stocks, and this resulted in the accumulation of large stocks at the smelters. However, the American Smelting & Refining Co. held the market steady at 6 cents per pound until June, when the price was shaded one-fourth cent per pound, followed by a cut of one-half cent per pound about August 1. Another cut of one-half cent per pound came about the 1st of September and brought the price down to 4.75 cents per pound, just a little above the price of lead at London. No further change occurred until the first week in November, when the American Smelting & Refining Co. withdrew its support from the market, which by the middle of December had dropped below 3.5 cents per pound.

The London lead market gradually strengthened from the opening until the middle of the year, when there were sharp oscillations in response to the break in New York prices. A drop in July and

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August was recovered by the last week in September, when London prices were nearly equal to New York prices. This was followed by a heavy decline, which touched bottom late in December.

1908.

After reaching the minimum late in December of 1907, lead began to advance in price at New York, and with returning confidence in business and increased activity in the building trades continued to rise until the maximum was reached, at 4.6 cents per pound, about the middle of August. At this time the increased production of western mines, stimulated by the better conditions, began to reach the market, with the result that prices began a gradual decline, which lasted until the close of the year.

The London market, on the contrary, lost ground until the middle of the year, when the low point was reached at £12 6s. 3d. per long ton (2.67 cents per pound). For the last half of the year the price of lead remained nearly level.

With the exception of the month of February at New York, both curves seem to represent natural markets directly responsive to supply and demand. When the difference between London and New York prices is more than the tariff differential on lead in ore—that is, 1½ cents per pound—then the markets are mutually sympathetic. When the difference is less than this amount, naturally the American market is independent.

1909.

The curve of lead prices at New York in the first five months of 1909 indicates a natural market, rising and falling in entire independence of the London market. Through the latter half of the year, for the most part, prices maintained artificial levels, relieved during December by a considerable rise.

The curve of the London lead market for the year registers several slight fluctuations in the first four months, but after the formation of the Lead Convention, May 1, the line shows only gentle oscillations in price. The range of weekly averages was not over three-tenths of a cent during the whole year.

1910.

The New York lead price curve for 1910 is a succession of level lines broken by slight advances and declines. The lowest point was reached in May, in sympathy with a depression in the London market. The range in weekly averages for the year was a little over four-tenths of a cent.

The London weekly average prices had a range of about three-tenths of a cent, and the curve for the year shows few oscillations. The low point was reached the first week in May, coincident with the renewal of the Lead Convention. With the close of 1910 the average weekly price of lead at London had fluctuated between 3 cents and a little under 2.7 cents for two and a half years.

New York and London prices preserved a close parallelism during the year. The average difference between the two markets was a little over 1.6 cents.

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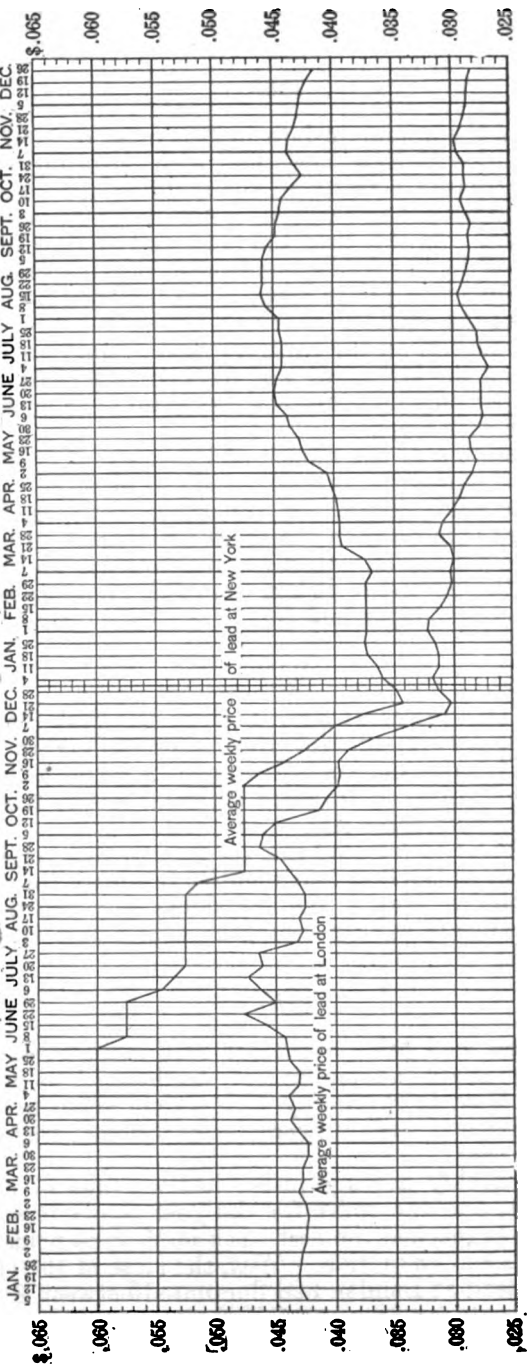

FIGURE 2.—Average weekly price of lead at New York and London in 1907 and 1908.

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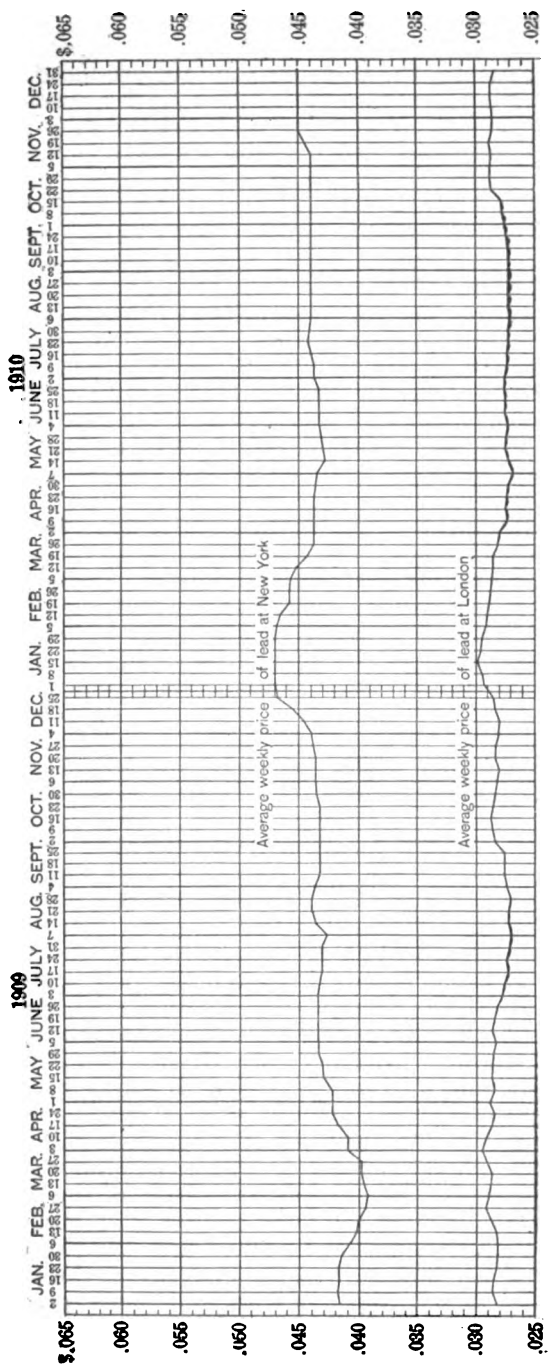

FIGURE 3.—Average weekly price of lead at New York and London in 1909 and 1910.

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VALUE.

The value of the 372,227 short tons of lead produced in the United States in 1910 from domestic ores, based on the average New York price, was $32,755,976, as compared with 354,188 short tons produced in 1909 and valued at $30,460,168, and with 310,762 short tons produced in 1908 and valued at $26,104,008.

CANADIAN LEAD BOUNTY.

The bounty paid by the Dominion of Canada to lead producers amounts to 75 cents per 100 pounds lead content of Canadian ore delivered to Canadian smelters when the London price of lead does not exceed £14 10s. per long ton (3.15 cents per pound). With increase in the price of lead, the bounty decreases at the same ratio, ceasing altogether when lead is about £18 per long ton (3.91 cents per pound). The result of the bounty is to maintain to the producers a steady value for lead, under the present arrangement, of £18 per long ton.

Upon the termination of the first period of five years of operation of the bounty on June 30, 1908, it was renewed for a second period of five years, with the maximum and minimum London price limits each raised £2 per long ton, giving the figures cited above. The lead production of Canada is chiefly from the mines of British Columbia. Prior to the enactment of the bounty this lead was largely smelted and refined in the United States, but since that time the ore has been smelted in Canada.

For the fiscal year ending June 30, 1910, the production of lead was 45,467,545 pounds, upon which the bounty was $340,542, as compared with 42,533,287 pounds and $307,432 bounty in the fiscal year 1909.

THE LEAD CONVENTION.

At the close of 1910 the Lead Convention had been in operation over a year and a half. Formed at Paris early in 1909, the convention, known as the International Sales Association, became effective May 1 of that year. It is composed of Spanish, Belgian, and German producers and metal-selling companies, together with Australian and American producers who consign lead to the European markets. The principal German producer, the Braubach silver-lead works, though not a member of the association, is acting in concert. The object of the association is to eliminate price cutting and sharp fluctuations and, by the establishment of a common selling agency and the allotment of spheres of sales, to introduce economies in the sale and delivery of lead. The Metallgesellschaft is the selling agency and Frankfort on the Main the main market for metal controlled by the association, which is said to be about half the European supply.

At the close of the first year of the convention there were rumors of dissatisfaction among the members and many predictions were made that the association would not be renewed. After a period of uncertainty which forced lead down during the first week of May to the lowest price of the year, the convention was established for another year. The association has had to meet the active competition of the independent producers and of the other large metal houses,

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in particular of Beer, Sondheimer & Co., who, through their Australian contracts and their control of the output of certain Spanish works and of the Rhine-Nassau and Overpelt works, were able to offer effective opposition. Lead closed the year 1910, after 20 months of operation of the convention, at practically the same figure at which that period opened. If the association was profitable to its members that profit was not gained from higher prices. That prices have been more stable and less subject to sudden fluctuations since the organization of the convention is evident from the price curves shown in figures 2 and 3 on preceding pages.

SUMMARY.

The following tabular statement gives the general items regarding domestic and world production and consumption of lead. The figures for domestic items are those compiled by this office, and the figures for the world items are based upon statistics compiled by the Metallgesellschaft.

Summary of lead statistics, 1907–1910, in short tons.

	1907	1908	1909	1910
Production of refined lead in the United States	414,189	396,433	448,112	470,380
Production of desilverized lead in the United States	284,432	265,551	296,890	301,136
Production of soft lead in the United States (including desilverized soft)	129,757	130,882	151,222	169,244
Production of antimonial lead in the United States	9,910	13,629	12,896	14,069
Total production of lead from domestic ores	365,166	310,762	354,188	372,227
Production of secondary lead in the United States	25,498	18,533	41,149	55,323
Consumption of lead in the United States (disregarding stocks)	386,711	336,292	368,853	394,588
World production (approximate)	1,095,174	1,148,180	1,164,709	1,211,411
World consumption (approximate)	1,095,270	1,164,335	1,177,608	1,196,842
United States (domestic) percentage of world production	33.3	27.1	30.4	30.7
United States percentage of world consumption	35.3	28.9	31.3	33.0
World rank of United States in production of lead	First.	First.	First.	First.
World rank of United States in consumption of lead	First.	First.	First.	First.

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ZINC.

By C. E. SIEBENTHAL.

INTRODUCTION.

An estimate of the production of primary[1] spelter in 1910 was given out in the form of a press bulletin on January 2, 1911. This was based on reports from every smelter and gave the actual production for the first 10 or 11 months with an estimate for the remainder of the year. The total thus obtained was about two-thirds of 1 per cent less than the final figures which were given in the advance statement of spelter production and consumption published February 18, 1911.

The present report includes the final figures as given out and contains in addition tables of imports and exports of spelter and of zinc ore, a comparison of mine and smelter returns, a list of zinc smelters, a brief review of the advance in metallurgy and ore dressing as applied to zinc ores, and finally a résumé of the domestic and foreign conditions of the zinc industry.

The statistics of production in this country have been compiled by the United States Geological Survey from confidential reports by each zinc smelting company in operation during 1910, except one small plant, using both ore and skimmings, which refused to report. For this company a close estimate of the spelter made from ore, amounting to only a few hundred tons, has been obtained. Statistics of the recovery of secondary zinc were collected from all the important secondary smelters and refiners. The statistics of domestic consumption are taken in part from the smelter returns and in part from the records of the Bureau of Statistics of the Department of Commerce and Labor, and the tables for foreign production and consumption were compiled from the sources indicated.

STATE OF ZINC INDUSTRY IN 1910.

The production of domestic primary spelter in 1910 was 252,479 short tons, valued at $27,267,732, based on the average St. Louis price, as compared with 230,255 short tons, valued at $24,864,300, based on the average St. Louis price, in 1909.

The production of spelter in 1910 was the greatest in the history of the zinc-smelting industry of the United States. Along with the

[1] In Mineral Resources for 1906, p. 461, zinc derived from ore was called "primary" spelter to distinguish it from the secondary spelter recovered from such sources as drosses, skimmings, and old metal. The former has also been called "virgin" spelter, and the latter has been called "remelted," "reclaimed," and "dross" spelter. The distinctive origin is more plainly suggested by the terms "primary" spelter and "secondary" spelter, and they are used herein. Where the word "spelter" is used without qualification primary spelter will be understood.

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great production there was a large reduction in the apparent consumption of spelter, so that there was naturally an increase in smelter stocks, the figures for the close of 1910 showing over 12,000 tons in excess of stocks at the beginning of the year. Imports of spelter were about normal, but exports were quadrupled. It was pointed out in the chapter on zinc in Mineral Resources for 1909 that the excessive apparent consumption of that year was probably due to an accumulation of stocks in the hands of consumers and dealers, stocks not taken into account by the Survey in the calculation of apparent production. The reduction of consumers' stocks and the increase in smelter stocks in 1910 is responsible for the smaller apparent consumption in that year, the actual consumption being no doubt about normal. The total production of spelter in 1910 was equal to the output of 63,367 average retorts operating continuously throughout the year, or about 72 per cent of the effective smelting capacity in 1910. The United States retained first place in the world's production of spelter with 30.5 per cent of the total output.

In this country a feature of the year was the beginning of the long threatened exodus of smelters from Kansas owing to the exhaustion of the natural gas fuel supply. The new locations have been chosen with reference to supplies of ore and fuel, and to markets for both spelter and sulphuric acid. New smelters and additions to capacity are under construction in the gas regions of Oklahoma, and in the coal fields of Illinois, West Virginia, and Pennsylvania. The retention in Kansas of the newer, better situated zinc smelters is assured for a number of years yet, however, by the discovery of sporadic gas wells, by the construction of pipe lines from the gas fields of Oklahoma, and by the use of crude oil as fuel, which has been successfully employed in roasting and distillation furnaces and, although more expensive than gas, is less so than coal.

Another feature of the year was the acquisition of zinc mining lands in the Joplin region, in the upper Mississippi Valley region, in Tennessee, and in the Western States by certain zinc smelting companies. A natural consequence was the inauguration of mining operations by those companies and by others owning zinc lands, but heretofore operating them on a leasing basis.

Still another feature was the effort on the part of the Zinc Ore Producers' Association of Joplin to establish a weekly scale of ore prices based directly on the average St. Louis price of spelter for the preceding week. Near the close of the year contracts were entered into by several smelters and a number of operators by which about half the weekly ore tonnage of the district was contracted for under the terms of the scale. Much difference of opinion exists as to the practical effect of the innovation, and experience alone can show its value.

Abroad the main event of the year was the termination of the first stipulated period of the Zinc Convention and its successful extension to April 30, 1914. Owing to reported dissensions among members in the earlier part of the year, the renewal of the convention was for a time in doubt. Both its extension and the period of uncertainty were closely reflected in the trend of the London spelter market.

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PRODUCTION.

ANNUAL PRODUCTION, 1873–1910.

The production of spelter in the United States began in 1858 in an experimental way [1] and regular production began in 1860 at the Lehigh Zinc Works in the East and at the Matthiesson & Hegeler works in the West. Between 1864 and 1870 nine or ten other zinc smelters were established. Statistics of production are recorded for the years 1873 and 1875, and for the census year ending May 31, 1880. Annual statistics have been collected by the United States Geological Survey since 1882. The annual progress of the zinc-smelting industry since 1873 is shown in the following table:

Annual production of spelter in the United States from domestic and foreign ores, 1873–1910, in short tons.

Year.	From foreign ore.	From domestic ore.	Total.	Year.	From foreign ore.	From domestic ore.	Total.
1873	.....	7,343	7,343	1895	.....	89,686	89,686
1875	.....	15,833	15,833	1896	.....	81,499	81,499
1880	.....	23,239	23,239	1897	.....	99,980	99,980
1882	.....	33,765	33,765	1898	.....	115,399	115,399
1883	.....	36,872	36,872	1899	.....	129,051	129,051
1884	.....	38,544	38,544	1900	.....	123,886	123,886
1885	.....	40,688	40,688	1901	.....	140,822	140,822
1886	.....	42,641	42,641	1902	.....	156,927	156,927
1887	.....	50,340	50,340	1903	.....	159,219	159,219
1888	.....	55,903	55,903	1904	.....	[a] 186,702	186,702
1889	.....	58,860	58,860	1905	.....	[a] 203,849	203,849
1890	.....	63,683	63,683	1906	25,076	199,694	224,770
1891	.....	80,873	80,873	1907	26,115	223,745	249,860
1892	.....	87,260	87,260	1908	19,675	190,749	210,424
1893	.....	78,832	78,832	1909	25,535	230,225	255,760
1894	.....	75,328	75,328	1910	16,705	252,479	269,184

[a] Including an unknown quantity smelted from foreign ore, small in 1904 but larger in 1905.

PRODUCTION BY STATES.

Two tabulations of the spelter production of the country for a period of years are given, one showing the locality from which the ores were derived, the other the locality in which they were smelted. Each method has its special interests and advantages, depending on whether the view point be that of producer or consumer, or that of resources.

The State totals given below are compiled entirely from confidential reports by each company engaged in smelting zinc ores in the United States in the year in question. Only primary spelter is here included, the recovery of secondary spelter being given in a later table.

The following table shows the sources of all ores and concentrates smelted for spelter in the United States in 1906–1910 and the quantity of spelter actually derived from the ores from these respective sources. Statistics of production according to source of ore were not collected prior to 1906.

[1] Ingalls, W. R., Lead and zinc in the United States, p. 314.

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Production of primary spelter in the United States in 1906–1910, apportioned according to source of ore, in short tons.

Source.	1906	1907	1908	1909	1910	
	Quantity.	Quantity.	Quantity.	Quantity.	Quantity.	Percentage of total.
Arizona	64	77	152	2,862	2,594	1.03
Arkansas	1,801	1,911	2,002	135	286	.11
California		140	27			
Colorado	32,456	26,077	24,885	20,121	23,238	9.20
Idaho	573	3,508	581	901	3,454	1.37
Illinois	282	1,446	298	675	1,551	.61
Iowa	201	220	516		40	.02
Kansas	3,902	13,850	8,628	9,185	10,220	4.05
Kentucky	335	358	341	22	29	.01
Maine		1				
Missouri	130,348	141,824	123,655	140,676	140,652	55.71
Montana	1,415		900	4,725	12,408	4.91
Nevada	1,768	1,692	398	825	1,516	.60
New Jersey	11,206	13,573	6,926	16,035	20,217	8.01
New Mexico	555	136	134	3,961	4,911	1.95
Oklahoma		719	2,235	3,008	2,297	.91
Tennessee	124	181	341	695	925	.37
Texas	8	16				
Utah	2,449	1,972	282	5,960	7,221	2.86
Virginia	1,143	771	910	58	1,168	.46
Washington	7					
Wisconsin	11,057	15,273	17,538	20,381	19,752	7.82
Total from domestic ores	199,694	223,745	190,749	230,225	252,479	100.00
Foreign:						
British Columbia	201	545	2,425	978	3,304	
Mexico	24,875	25,570	17,250	24,557	13,401	
Total from foreign ores	25,076	26,115	19,675	25,535	16,705	
Grand total	224,770	249,860	210,424	255,760	269,184	

The subjoined table shows the localities in which spelter was made:

Production of spelter in the United States, 1873–1910, apportioned according to locality in which smelted, in short tons.

Year.	Illinois.	Kansas.	Missouri.	Oklahoma.	Eastern.	Southern.	Colorado.	Total.
1873								7,343
1875	6,678	600	4,650		3,305			[a] 15,833
1880 (census)	10,904	2,451	5,671		4,213			23,239
1882	18,201	7,366	2,500		5,698			33,765
1883	16,792	9,010	5,730		5,340			36,872
1884	17,594	7,859	5,230		7,861			38,544
1885	19,427	8,502	4,677		8,082			40,688
1886	21,077	8,932	5,870		6,762			42,641
1887	22,279	11,955	8,660		7,446			50,340
1888	22,445	10,432	13,465		9,561			55,903
1889	23,860	13,658	11,077		10,265			58,860
1890	26,243	15,199	13,127		9,114			63,683
1891	28,711	22,747	16,253		8,945	4,217		80,873
1892	[b] 31,383	24,715	16,667		9,582	4,913		87,260
1893	[b] 29,596	22,815	13,737		8,802	3,882		78,832
1894	[b] 28,972	25,588	11,992		7,400	1,376		75,328
1895	[b] 35,732	25,775	14,998		9,484	3,697		89,686
1896	[b] 36,173	20,759	14,001		8,139	2,427		81,499
1897	[b] 37,876	33,396	18,125		7,218	3,365		99,980
1898	[b] 47,103	40,132	19,533		8,631			115,399
1899	[b] 50,118	52,021	18,107		8,805			129,051
1900	[b] 38,750	62,136	14,741		8,259			123,886
1901	[b] 44,896	74,240	13,083		8,603			[a] 140,822
1902	[b] 47,096	86,564	11,087		12,180			[a] 156,927
1903	[b] 47,659	88,388	9,994		12,301		877	[a] 159,219
1904	47,740	107,048	12,150		14,893		4,871	[a] 186,702
1905	46,606	114,287	11,844		24,513		6,599	[a] 203,849
1906	47,939	129,564	11,077		29,930		6,260	224,770
1907	56,056	134,108	11,732	5,035	37,626		5,303	249,860
1908	50,244	99,298	10,201	14,864	32,738		3,079	210,424
1909	67,653	103,299	7,037	28,782	42,941		6,048	255,760
1910	73,038	105,697	5,571	34,760	43,606		6,512	269,184

[a] Secondary spelter included: 600 tons in 1875; 2,716 tons in 1901; 2,675 tons in 1902; 3,302 tons in 1903; 3,300 tons in 1904; and 1,469 tons in 1905.

[b] Includes also the production of smelters in Indiana.

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The following curves show graphically the production and consumption of spelter in the United States in the period for which there is record. The curves are made up of 9-year averages, that is, the point in the curve representing each year is the average of the actual quantity for the year as well as of the four years preceding and the four years following that year. This method practically eliminates the effects of temporary factors affecting the production or consumption for one or two consecutive years. The resulting curves therefore approach the true curves of normal production and consumption. Naturally the effects of the method are less pronounced near the ends of the curves, which remain more or less ragged. No

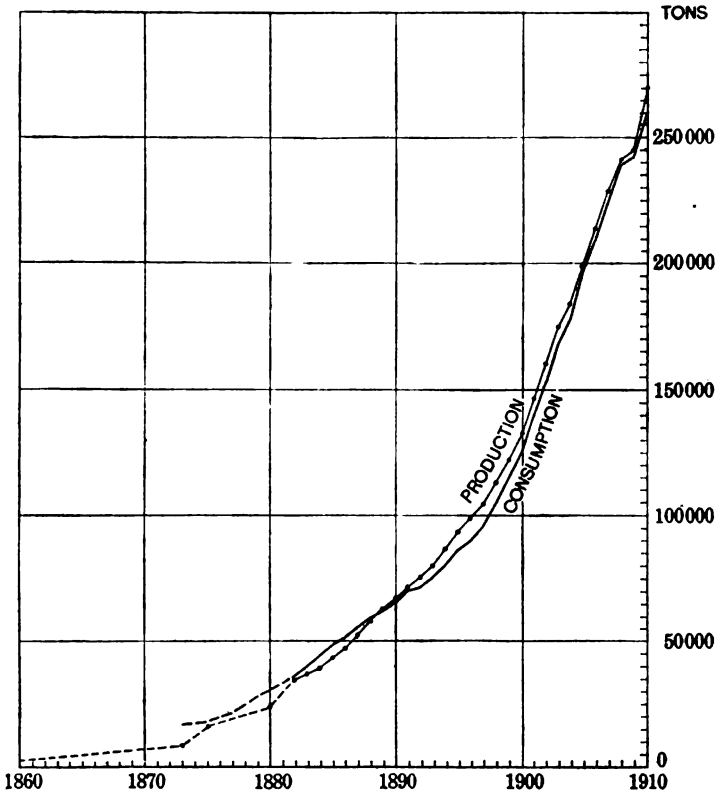

FIGURE 1.—Curves of spelter production and consumption, 1873–1910.

distinction is made between spelter of domestic and of foreign origin in this table. From the beginning of the period until 1888 the average consumption exceeded production. Since that year the average production has always exceeded the average consumption.

ZINC DUST.

Zinc dust is an impalpable powder which forms in the distillation of zinc when the zinc vapor is cooled too rapidly in the condensers or is diluted by too large a volume of other gas. It may constitute a large proportion of the metallic zinc obtained in electrothermic zinc

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smelting, but in ordinary retort smelting it usually amounts to between 3 and 10 per cent of the reduced zinc. The powder consists of metallic zinc, with about 10 per cent zinc oxide, which probably exists as a film surrounding the metallic particles. These particles can not be made to coalesce by heating unless under great pressure but must be again vaporized and condensed. Marketable zinc dust must not contain more than 10 per cent of zinc oxide and must pass through a screen of 100 meshes to the inch.

Zinc dust differs from metallic zinc in other physical properties, such as rapid oxidation, absorption of hydrogen, and generally greater chemical activity, resulting at times in spontaneous combustion or explosion. These properties are believed by Sang [1] to be due to conditions of stress resulting from rapid solidification, somewhat analogous to the condition in "Prince Rupert's drops."

These peculiar properties of zinc dust are the cause of many of its uses. Under the name of "indigo auxiliary" a paste of zinc dust is used to discharge locally the color in dyeing cotton goods, giving a white pattern on the background of dye. Zinc dust is used in fireworks and in making hydrogen for balloons. It is the basis of the various methods of dry galvanizing and is also used to furnish the zinc solution in electrozincing. One of the most important uses of zinc dust is as a substitute for zinc shavings in zinc precipitation in the cyanide treatment of gold and silver ores. For this purpose it is cheaper, quicker, more effective, and more convenient than zinc shavings and the saving in costs is about one-third.

In American zinc-smelting practice, heretofore, the zinc dust has been charged back into the retorts, since, under the former tariff, if sold as dust, it came into competition with foreign zinc dust admitted free of duty, whereas recovered as spelter it was protected by an import duty of 1½ cents per pound. Hence the small quantity of zinc dust heretofore used in this country has been imported from Belgium and Germany. The tariff act of 1909, as shown on a later page, established an import duty upon zinc dust of 1⅜ cents per pound.

A new ruling of the Interstate Commerce Commission lists zinc dust and zinc flue dust as inflammable solids and directs that they must bear a yellow shipping label. Paragraph 1834 of the ruling covering this product reads as follows: "Packages must be tight and strong, and the interior packages must be so cushioned and secured that no rupture of either package can result from the ordinary shocks incident to transportation."

The United States Zinc Co. about the middle of the year began the preparation of zinc dust for market in the smelter at Pueblo, Colo. Press reports from Denver credit the plant with an initial daily output of 500 pounds of zinc dust which was later doubled in quantity. The market is mainly western, and the product is used for zinc-dust precipitation in cyaniding in South Dakota, Nevada, and elsewhere.

As there is but one producer the quantity and value of the output can not be disclosed, but it has been included in the zinc content of pigments in the following sections. For imports and prices, see under those headings in later sections of this report.

[1] Sang, Alfred, Old and new methods of galvanizing: Proc. Eng. Soc. Western Pennsylvania, vol. 23, 1907, pp. 546–571.

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ZINC PIGMENTS.

There are four white pigments which have zinc for a base, either in whole or in part; namely, zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone. All of these may be, and in the United States the first three usually are, made directly from ore.

Zinc oxide is the most important of these pigments. In European practice the oxide is made from spelter, though in France zinc oxide is made from ore in the electrothermic furnace invented by Côte and Pierron. In the United States the oxide is generally made from ore, but in 1910 of the total production 3,627 tons was made from spelter, as compared with 3,255 tons in 1909. The production of zinc oxide fell off greatly in 1910, being 59,333 short tons, as compared with 68,974 tons in 1909 and with 57,237 tons in 1908. The imports for consumption of zinc oxide in 1910 were 3,265 short tons, and the exports for the same period were 13,167 short tons.

Leaded zinc oxide and zinc-lead oxide are produced from ore, both in some cases at the same plant, the zinc-lead containing somewhat the larger percentage of lead. No zinc-lead oxide was made in 1910. The production of leaded zinc pigment in 1910 was 7,111 short tons.

Lithopone is an intimate mixture by chemical precipitation of zinc sulphide and barium sulphate. It may be manufactured from spelter or zinc oxide, but in the United States it is now generally made from zinc skimmings, ashes, and scrap.

The zinc content of the various zinc pigments made in the United States in 1910 from ore, both domestic and foreign, was 50,660 short tons, as compared with 54,139 tons in 1909. The quantity given for 1910 includes the zinc contents of the zinc dust produced by the United States Zinc Co., which can not be disclosed separately, there being at present but a single producer.

For further details of the production of zinc pigments the reader is referred to the chapter on Mineral Paints in Part II of Mineral Resources for 1910.

SECONDARY ZINC.

In the ordinary method of galvanizing, where the material to be coated is dipped into a bath of molten zinc, there is great loss of zinc in the form of semioxidized skimmings and of hard zinc drosses, caused by the alloy formed by the zinc with the iron of the tank and of the article being galvanized. In the larger galvanizing plants there are furnaces to refine these skimmings and drosses and to recover the spelter. There are also many small plants and some large ones which make a practice of buying galvanizers' skimmings and drosses and of recovering the spelter. A considerable quantity of old metal in the form of various alloys of zinc with copper and other metals is also worked over and brought up to the desired composition by the addition of new metal. At almost every brass foundry and machine shop in the country it is the custom to remelt and use brass filings, grindings, and scrap copper and brass, and it is manifestly impracticable to attempt to take full account of such material. Some of the zinc smelters running on ore find it advantageous to work in a quantity of secondary material. In such cases they have made the proper returns to the United States Geological Survey, and account has heretofore been taken of such production in these reports as

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dross or secondary spelter. As such spelter has been recovered by redistillation, it is practically indistinguishable in quality from spelter of ordinary grades made from ore. Several secondary smelters recovering zinc from drosses do so by redistillation. It has seemed advisable that the secondary spelter recovered by redistillation should be separated from that recovered by remelting and it has accordngly been done in the table below.

Since 1907 statistics have been collected from the secondary smelters and refineries, for the first two years by the writer, and since, by J. P. Dunlop, of the United States Geological Survey. In 1907 and 1908 reports were obtained from the larger plants only, but in 1909 the scope of the canvass was greatly enlarged, since which time the number of firms has been increased from about 40 to double that number, with a large increase in reported production. The following table gives the production of secondary zinc in the United States, and a later table gives the production of secondary spelter in Europe:

Production of secondary zinc in 1907–1910, in short tons.

	1907	1908	1909	1910
Secondary spelter, redistilled	7,050	7,159	9,273	12,784
Secondary spelter, remelted	11,791	9,811	23,767	28,439
Recovered zinc in alloys, excluding old brass remelted	1,417	665	1,181	2,709
Recovered zinc in remelted brass	(a)	(a)	8,204	18,450
Secondary zinc recovered as metal	20,258	17,635	42,425	62,382
Secondary zinc recovered in pigment	863	1,091	1,968	2,371
Secondary zinc recovered in zinc chloride (b)	4,411	4,500	3,839	3,970
Total secondary zinc	25,532	23,226	48,232	68,723

a Statistics not collected.
b These figures include only the quantity of zinc in zinc chloride used in wood preservation treatment, and were furnished by courtesy of the Forest Service, Department of Agriculture.

Besides the increased recovery of secondary zinc as spelter and in alloys, there was increased use of zinc skimmings and drosses in the manufacture of zinc pigments and lithopone and of zinc chloride. The zinc content of pigments and lithopone made from secondary zinc in 1910 was 2,371 tons, as compared with 1,968 tons in 1909. The zinc content of zinc chloride manufactured from secondary zinc and used in the treatment of railroad ties, bridge timbers, etc., in 1910, based on the consumption of zinc chloride for wood preservation as reported by the Forest Service of the United States Department of Agriculture, is estimated at 3,970 tons, as against 3,839 tons in 1909, 4,500 tons in 1908, and 4,411 tons in 1907.

The exports of zinc dross continue to decrease. They were 4,724 short tons in 1910, as compared with 7,069 short tons in 1909, 8,405 tons in 1908, 9,593 tons in 1907, and 15,887 tons in 1906, thus supplementing the figures of increased recovery of secondary zinc. It is to be expected that exports of zinc dross will cease altogether in time, as the zinc contents are normally worth more in this country than abroad because of the import duty on zinc.

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COMPARISON OF STATE TOTALS, BASED ON SMELTER AND ON MINE REPORTS.

The foregoing figures of the production of spelter by the respective States are compiled from reports from individual zinc smelters. For several years the production of the more valuable metals in the Western States has been also obtained by the United States Geological Survey from reports of individual mines, and since 1907 this has been extended over the whole country. In order to put the smelter production on the same basis as the mine figures, all the zinc which is manufactured into pigment directly from ore (excluding the quantity in zinc oxide manufactured from spelter, the inclusion of which would entail its duplication in the totals) is added to the production of metallic zinc. The zinc dust recovered by the United States Zinc Co. in 1910 is also included here. The zinc recovered from secondary sources is excluded, since it has already been once reckoned as spelter. These facts must be borne in mind in comparing this table with the table showing the production of spelter. The State totals obtained by each method are compared in the following table:

Comparison of State totals of production of zinc, 1907–1910, based on smelter and mine reports, in short tons.

State.	1907				1908			
	Totals based on smelter reports.	Totals estimated from mine reports.	Differences.		Totals based on smelter reports	Totals estimated from mine reports.	Differences.	
			Smelter excess.	Mine excess.			Smelter excess.	Mine excess.
Arizona	89	114	.....	25	152	339	.....	187
Arkansas	1,911	474	1,437	.....	2,002	605	1,397	.....
California	140	116	24	.....	27	0	27	.....
Colorado	33,644	26,394	7,250	.....	29,907	15,065	14,842	.....
Idaho	3,508	3,493	15	.....	581	19	562	.....
Illinois	1,468	737	731	.....	298	1,717	.....	1,419
Iowa	220	145	75	.....	516	395	121	.....
Kansas	13,850	17,772	.....	3,922	8,628	14,119	.....	5,491
Kentucky	385	0	385	.....	341	0	341	.....
Maine	1	0	1	.....	0	0	.....	.....
Missouri	142,024	116,752	25,272	.....	123,655	107,404	16,251	.....
Montana	0	122	.....	122	900	820	80	.....
Nevada	1,692	1,084	608	.....	398	558	.....	160
New Jersey	59,588	69,369	.....	9,781	47,643	67,165	.....	19,522
New Mexico	1,038	375	663	.....	616	1,788	.....	1,172
Oklahoma	719	1,657	.....	938	2,235	4,529	.....	2,294
Tennessee	181	109	72	.....	341	344	.....	3
Texas	16	22	.....	6	0	18	.....	18
Utah	2,447	2,726	.....	279	282	730	.....	448
Virginia	771	0	771	.....	910	705	205	.....
Wisconsin	16,984	18,490	.....	1,506	18,598	18,206	392	.....
Total	280,676	259,951	.....	.....	238,030	234,526	.....	.....

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Comparison of State totals of production of zinc, 1907–1910, based on smelter and mine reports, in short tons—Continued.

State.	1909				1910			
	Totals based on smelter reports.	Totals estimated from mine reports.	Differences.		Totals based on smelter reports.	Totals estimated from mine reports.	Differences.	
			Smelter excess.	Mine excess.			Smelter excess.	Mine excess.
Arizona	2,862	2,989	.....	127	2,594	2,742	.....	148
Arkansas	135	510	.....	375	286	994	.....	708
California	0	0	.....	.....	0	0	.....	.....
Colorado	23,374	25,605	.....	2,231	25,883	38,545	.....	12,662
Idaho	901	676	225	.....	3,454	2,802	652	.....
Illinois	675	2,163	.....	1,488	1,551	3,549	.....	1,998
Iowa	0	35	.....	35	40	96	.....	56
Kansas	9,185	11,445	.....	2,260	10,220	13,229	.....	3,009
Kentucky	22	56	.....	34	29	6	23	.....
Maine	0	0	.....	.....	0	0	.....	.....
Missouri	140,811	130,162	10,649	.....	140,653	128,589	12,064	.....
Montana	4,725	4,680	45	.....	12,417	15,819	.....	3,402
Nevada	825	1,507	.....	682	1,551	1,354	197	.....
New Jersey	63,307	82,510	.....	19,203	65,419	68,678	.....	3,259
New Mexico	5,216	6,543	.....	1,327	5,889	9,044	.....	3,155
Oklahoma	3,008	7,806	.....	4,798	2,297	6,394	.....	4,097
Tennessee	695	596	99	.....	925	966	.....	41
Texas	0	0	.....	.....	0	0	.....	.....
Utah	5,960	4,930	1,030	.....	7,288	8,184	.....	896
Virginia	58	58	.....	.....	1,168	794	374	.....
Wisconsin	21,414	23,152	.....	1,738	21,475	25,927	.....	4,452
Total	283,173	305,423	.....	.....	303,139	327,712	.....	.....

The smelter State totals represent actual recovery and are found by summing up the total production reported by all companies for each State, respectively, all pigments being recalculated back to equivalent metallic zinc on the basis of average analysis of product. In compiling the mine totals each producing property is requested to report actual tonnage of zinc ores and concentrates shipped, and from this the zinc content is reckoned by assay value. From that zinc content 12 to 25 per cent, according to the character of the ore, is deducted for smelting losses, and the remainders thus obtained from all the producing properties in each State are combined to afford the total for the respective States. Where the ore is concentrated at a custom mill proper allowance is also made for the loss of metal in the process. It is clear that by either method the correctness of the totals is dependent upon complete and correct returns from each producing mine and smelter. It is further essential to the correctness of the mine totals that the assay content and the theoretical recovery be correctly estimated. Theoretically, the State totals, as compiled from smelter reports and from mine reports, respectively, should in the long run agree fairly closely. As a matter of fact, for any year they show considerable divergence These discrepancies, giving rise to "smelter excess" or "mine excess," may be the result of one cause or of a combination of causes. among which are: Lag in the smelting of the ore, resulting in accumulation of ore stocks at the smelters; lag in the mining, owing to which the smelter depletes its ore stocks; error in calculating metallic contents from assay and in estimating recovery; and error by smelters in exact distribution of spelter, by States, according to source.

Of these sources, the greater discrepancies arise from erroneous distribution by the smelters, in particular as among the States in the

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Joplin region and in the upper Mississippi Valley region. Smelters using ore from the Joplin region are prone to credit it to Missouri because bought through their agents at Joplin. Similarly, in the upper Mississippi region the ore is apt to be credited to Wisconsin because bought through a Wisconsin buyer. In each region there are companies operating in more than one State but selling ore through a central office—a condition which likewise leads to error in distribution. Another cause for such error, particularly in the upper Mississippi region, is found in the electrostatic and electromagnetic separation plants, the ore from which is naturally credited to the State in which the plant is located.

The smelter reports give the exact annual production of zinc and serve as a check on the mine production, and they also give the form in which the zinc was recovered, whether as spelter or as pigment. The distribution among States by the smelter reports has value as a check on the mine State totals, and also because of the earlier publication, but for exact distribution of zinc production according to origin, recourse must be had to mine reports.

MINE AND SMELTER TOTALS, 1910.

The mine excess in Arkansas is due in part to erroneous distribution by smelters, ore from that State being probably attributed to Missouri. The mine excess in Colorado is very probably due to lag, as it is known that there are large stocks of zinc ore derived from Colorado now in the hands of smelting companies. The smelter excess in Idaho is the fourth successive difference of this kind, and must be due to erroneous distribution by the smelters. The mine excess in Illinois is due to error in distribution by smelters, for which there are several causes, as outlined in the preceding page. The similar mine excesses in Kansas and Oklahoma are due to similar causes, as also explained in the preceding page. The mine excess in New Jersey is more than accounted for in the zinc content of the 19,711 short tons of exported willemite ore. The mine excesses in Montana, New Mexico, and Utah seem to be due to lag, as there was a great increase in zinc ore production in these States in 1910, a condition which favors the accumulation of ore stocks from those States at the smelting plants. The mine excess in Wisconsin is largely, if not altogether, due to lag.

RESOURCES.

UNITED STATES.

MINE PRODUCTION OF ZINC.

The following table shows, for each zinc-producing State, the total quantity of zinc ore produced, and the output of each kind of zinc ore. The column headed "all other ore" includes lead ore, copper ore, copper-lead ore, and dry or siliceous ore, no zinc being recovered from any of these except in Colorado. "Dry" ores produced in that State in 1910 contained 2,248 short tons of recoverable zinc. The total crude ore yielding either gold, silver, copper, lead, or zinc is given for each zinc-producing State, so that a comparison may be made of the relative extent of deep mining operations for all

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five metals in these States, the amount of crude ore raised being the best measure for this purpose. The table discloses the fact that Missouri made nearly one-third of the crude ore production of the zinc-producing States, having an output of 12,748,420 short tons of crude ore, of which 9,054,897 tons was zinc bearing. Exluding iron ore, this was the largest production of metalliferous crude ore in the United States. Next in rank was Michigan, with 10,869,561 tons of crude copper ore.

The table gives also the quantity of recoverable zinc contained in the crude ores of each State and the quantity of zinc recovered from each kind of zinc ore. The percentage of recoverable zinc contained in the zinc ore and the zinc-lead ore of each State is also shown. The recoverable zinc content of crude zinc ore ranges from 35.8 per cent in Arizona down to 1.4 per cent in Missouri, the Western States having uniformly the higher percentage. The average recoverable zinc content of the zinc ore of the United States in 1910 was 2.5 per cent. Of the total mine production of zinc in 1910, a quantity corresponding to 89.1 per cent was derived from zinc ore, 10.2 per cent was derived from zinc-lead ore, and 0.7 per cent was recovered from all other ores. The figures of mine production of zinc are taken from the chapters on gold, silver, copper, lead, and zinc (mine production) in the various States appearing elsewhere in this volume.

Source of mine production of zinc in 1910, by States and kinds of ore, in short tons.

States.	Zinc ore.			Zinc-lead ore.			All other ore.		Total.	
	Crude ore.	Recoverable zinc content.	Per cent.	Crude ore.	Recoverable zinc content.	Per cent.	Crude ore.	Recoverable zinc content.	Crude ore.	Recoverable zinc content.
Arizona	7,650	2,742	35.8	.....	.....	.....	3,907,319	.....	3,914,969	2,742
Arkansas	35,000	994	2.8	.....	.....	.....	.....	.....	35,000	994
Colorado	82,251	13,494	16.4	244,414	22,803	9.3	2,107,999	2,248	2,434,664	38,545
Idaho	34,006	2,802	8.2	.....	.....	.....	1,752,168	.....	1,786,174	2,802
Illinois	111,078	3,549	3.2	.....	.....	.....	(a)	.....	a 111,078	3,549
Iowa	b 5,110	96	1.9	.....	.....	.....	.....	.....	b 5,110	96
Kansas	704,046	13,229	1.9	.....	.....	.....	.....	.....	704,046	13,229
Kentucky	b 300	6	2.0	.....	.....	.....	b 5,140	.....	b 5,440	6
Missouri	9,054,897	128,589	1.4	.....	.....	.....	3,693,523	.....	12,748,420	128,589
Montana	169,165	15,810	9.3	30	9	30.0	4,910,251	.....	5,079,446	15,819
Nevada	3,038	945	31.1	1,663	409	24.6	3,651,074	.....	3,655,775	1,354
New Jersey	375,677	68,678	18.3	.....	.....	.....	.....	.....	375,677	68,678
New Mexico	20,944	5,603	26.7	24,685	3,441	13.9	146,236	.....	191,865	9,044
Oklahoma	223,212	6,394	2.9	.....	.....	.....	.....	.....	223,212	6,394
Tennessee	25,638	966	3.8	.....	.....	.....	552,796	.....	578,434	966
Utah	4,954	1,284	25.9	231,278	6,900	3.0	6,153,166	.....	6,389,398	8,184
Virginia	10,066	794	7.9	.....	.....	.....	6,910	.....	16,976	794
Wisconsin	1,032,052	25,927	2.5	.....	.....	.....	.....	.....	1,032,052	25,927
Total	11,899,084	291,902	2.5	502,070	33,562	6.7	26,886,582	2,248	39,287,736	327,712
Per cent of total zinc derived from each kind of ore	89.1			10.2			0.7		100.0	

a Exclusive of fluorspar ore mined in southern Illinois.
b Estimated.

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BRIEF REVIEW OF ZINC-PRODUCING DISTRICTS.

For details of production in the various zinc-producing districts of the country the reader is referred to the mines reports for the individual States, appearing elsewhere in this volume. Only the general trend of development during the year will be here noticed in connection with the different districts.

The chief zinc-producing district in the eastern part of the United States is the famous Franklin Furnace region of New Jersey embracing the great zinc deposits of Sterling Hill and Mine Hill. The former was mined continuously from about 1875 until 1900 and the latter is making near its maximum yield after over 60 years of active mining. The production in 1910 showed a slight decrease from that of 1909.

The Virginia-Tennessee area is the only other important zinc-producing region in the eastern part of the United States. The Virginia zinc mines made a larger output in 1910 than for several years, but it was mostly from tailings. The zinc carbonate and blende deposits of eastern Tennessee assumed considerable importance in 1909 and 1910, owing to the reopening of some old mines and the entry into the district of the Grasselli Chemical Co., which obtained control of several productive properties.

The upper Mississippi Valley region, embracing the adjoining areas of Wisconsin, Illinois, and Iowa, made about the same production as in 1909. The feature of the year 1910 was the extension of holdings by the leading operating companies in the district.

The Kentucky-Illinois district has had no important output of zinc ore for several years, for which condition two things are responsible—the difficulty of separating the zinc from the fluorspar with which it is generally associated and the stagnation in the fluorspar industry.

The Joplin region, embracing southwestern Missouri, southeastern Kansas, and northeastern Oklahoma, showed a loss of about 6 per cent in zinc produced as compared with the output of 1909. This was due to the shutting down of the sheet-ground mines of the Webb City district on account of low ore prices. Oklahoma also showed a decrease, but Kansas made a gain of 15 per cent over the 1909 production. Among the features of the year was the opening of the Thoms station district in Missouri, with shallow soft-ground deposits of old-time richness; the development of promising deposits at Lawton, Kans.; the revivification of several old mining tracts at Galena; and the development of deeper deposits in the latter district and also at the north end of the Miami district in Oklahoma.

The zinc production of Arkansas in 1910 was about double the output in 1909. In both these years the greater part of the State's production was zinc blende, whereas in the two years preceding the major part of the mine output was zinc carbonate ore. This indicates that the depth of mining operations is increasing and augurs well for their persistence.

In New Mexico the output of zinc ore showed a good gain, thus continuing the rapid growth of the industry in that State since 1907. The zinc output of New Mexico came largely from the lead-zinc mines of the Magdalena district, Socorro County, and was a result

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principally of operations at the Graphic and Kelly mines. There was also production from the Hanover district, in Grant County.

Colorado made a noteworthy gain in zinc production, which was mainly owing to the general revival of mining and to the higher price of zinc making old tailing piles workable, but in part to the increase in the capacity of concentration mills handling the lead-zinc-iron sulphide ores now predominating. Moreover, the discovery of extensive bodies of zinc carbonate in the upper stopes of some of the older mines in the Downtown district of Leadville, led to a close scrutiny of old dumps and old workings with the result that the oxidized ore of zinc was found to occur widespread over the area heretofore mined for lead carbonate and the sulphides. The occurrence of this ore had been known for several years, and in 1909 two carloads were shipped to the smelter, but as the zinc content ran only about 20 per cent they were not available for use. The bodies since discovered and worked range upward from about 30 per cent of zinc. Some 8,059 tons of zinc carbonate were shipped from Leadville during 1910 with the promise of a greatly enlarged tonnage in 1911.

Montana in 1907 produced but a little over 100 tons of zinc. From that point the mine output has risen in successive years to 800 tons, to 4,700 tons, and finally to 15,819 tons in 1910, making the State rank fifth in zinc production in the whole country. This increase in production has come largely from the Butte district where the Black Rock, Elm Orlu, and Lexington mines were the principal producers. Special attention was paid to the development of zinc-ore bodies in 1910. The chief retarding influence at present is that of concentration. The Butte Reduction Works has a capacity of about 300 tons of ore per day, and the new Basin Reduction Co.'s concentrator is of about the same size. The concentration problem successfully solved, the Butte district will become a large zinc producer.

Idaho had an increased zinc production in 1910 owing to the resumption of operations by the Success mine after two years of non-production. The Success mine is at present the only important zinc producer in the Cœur d'Alene district, although as far back as 1905, zinc was shown to occur in notable quantities in the ore as mined. Bain[1] states that average analyses of the feed for seven months of two of the large mills showed from one-fourth to one-half as much zinc as lead, the actual percentages of zinc being 1.7 at one mill and 3.8 at the other. More recently writers have stated that the zinc is increasing with greater depth. The zincky portions of the ore shoots have usually been avoided in mining. Several of the larger mills have been altered to save the zinc and some small shipments have been made. At the Morning mill the MacQuisten flotation tubes are making a zinc concentrate from blende-barite-siderite middlings.

Utah has also made great gains in zinc output in the last few years and now ranks eighth in the production of that metal. The greater part of this zinc came from the Park City district and was the result of working over old dumps and zinc tailings. The Grasselli Chemical Co. has been operating a dry concentration plant upon these tailings since 1907, and in 1910 constructed a 125-ton wet concentrator for additional capacity. Zinciferous ores from the United States mines in the Bingham or West Mountain district were handled at the Midvale

[1] Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, p. 392.

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concentrator, the zinc middlings being re-treated in the Huff electrostatic separating plant. Smaller outputs of zinc came from the Frisco and North Tintic districts.

Arizona had an annual zinc production of but a few hundred tons prior to 1909, but in that year the output was increased to 2,989 tons. The production in 1910 showed a slight loss from that of 1909. This zinc was nearly all produced by the Golconda mine in the Union Basin, 12 miles northwest of Kingman, Mohave County. The ores of the oxidized zone worked at first yielded lead and silver, but below that zone the ore shoot consists of a vein 2 to 3 or more feet in thickness carrying a rich sheet of zinc-blende ore. The hand-picked ore assays from 45 to 48 per cent zinc, with some gold and silver. The ore body has been explored to a depth of 335 feet and opened laterally 700 or 800 feet, so that there is reported in sight about 20,000 tons of blende such as has been shipped. For each ton of sorted ore there are two tons of milling ore carrying about 20 per cent of zinc in a quartz gangue. A concentrating plant of 80 tons capacity was constructed during the year. The new concentrator at Needles, Cal., with the Huff electrostatic separator will also help to make available the zinc from other mines in this region.

Nevada's output of zinc remained about on a level with that in 1909. The whole production comes from the Yellow Pine district, Clark County, in the southern part of the State. The zinc ores are the oxidized forms, carbonates and silicates, with which occur lead carbonate, lead sulphide, and silver.

California had no production of zinc in 1910. There are deposits of zinc carbonate ore at the Cerro Gordo mines at Keeler, in Inyo County. These mines were for many years operated as lead mines, the zinc deposits having been discovered only recently. Zinc occurs in the copper ore of the Mammoth mine at Kennett and is reported to give trouble in the smelter. Zinc also occurs in the Bully Hill copper ores, and experiments are now under way with the object of developing a process for saving the zinc.

MEXICO.

The imports into the United States of zinc ores from Mexico in 1910 were just about up to the average of the last five years, though they fell off materially from the imports of 1909 which were doubtless abnormally large owing to the imminence of tariff legislation. The low price of zinc in 1910 and the tariff combined to discourage zinc mining and most of the ore shipped was delivered under previous contract. Certain changes in the Mexican railway tariffs, possibly designed in retaliation for the United States import duty, became effective at the beginning of the year. The new schedule increased the rate from the zinc districts of Northern Mexico to the United States $1.08 per ton and lowered that to Gulf ports $0.27 per ton. The difference in freight rates added to the United States import duty led to the consignment of several experimental lots of zinc ore to European smelters in the early part of 1910, but as yet no satisfactory arrangements have been made for continuous shipments on a large scale.

The perennial rumors of zinc smelters about to be constructed in Mexico have not developed into anything more than rumors.

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Zinc deposits are found in the Mexican States of Tamaulipas, Nuevo Leon, San Luis Potosi, Coahuila, and Chihuahua, but most of the ore imported into the United States has come from the two last mentioned.

CANADA.

A strong endeavor is being made in the Dominion of Canada to develop a commercially successful method of reducing the complex zinc ores of the Kootenay district of British Columbia. The Dominion Government appropriated $50,000 for experimental work, the preliminary research part of which is proceeding satisfactorily at McGill University upon sample lots of zincky ores from the silver-lead mines of the Kootenay region. The concluding work will be done at the Snyder electrothermic zinc smelter of the Canada Zinc Co. at Nelson, British Columbia. Independent experimentation is also under way at Nelson by the French Complex Ore Reduction Co. The scheme followed at the latter plant is to recover the zinc either as spelter or oxide, the silver and copper bearing leady residues being sold to lead smelters. An Elmore flotation machine is being installed at the Wakefield Mill in the Slocan district.

The zinc ore produced in British Columbia now finds its way to the zinc smelters of the United States. In the past the output of these ores has not assumed great importance, but there is no doubt of their extended occurrence, and should commercial success attend the efforts at reduction described above the district would become an important zinc producer. The question of a bounty similar to the lead bounty for the production of zinc ore in Canada has been agitated but so far without success.

AFRICA.

The Rhodesia Broken Hill ore body consists of a deposit of oxidized zinc-lead ore in northwestern Rhodesia, according to a report in the Mining Magazine. Large quantities of ore are in sight at the surface. One outcrop is estimated to show 250,000 long tons of ore averaging 26 per cent of lead and 22½ per cent of zinc, and another outcrop is figured at 300,000 long tons averaging 32 per cent zinc with little lead but much iron oxide and carbonate. The great difficulty has been to find a commercial process to treat the ore. Recently an agreement has been made with the owners of the Bradley-Williams process, and a company has been formed to acquire the Rhodesian rights to the process, which will be first tried on a small scale with a view of ascertaining the costs, as fuel and freight rates will enter largely into the commercial success of the treatment finally adopted. Preliminary tests of the process at Johnson & Sons' Smelting Works were technically satisfactory. The method consists in dissolving the zinc compounds in dilute zinc sulphate carrying a small proportion of free sulphuric acid. The circulation of this electrolyte is continuous, passing as it does first through the ore, then through the electrolytic cell, where metallic zinc is deposited, and the electrolyte is thus regenerated to its original strength by the removal of zinc and the liberation of sulphuric acid.

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AUSTRALIA.

The principal source of zinc in Australia is the silver-lead mines of Broken Hill, New South Wales. In the early days of Broken Hill mining the crude ore ran about 25 per cent each in lead and zinc and 25 ounces in silver, but by 1904 the average tenor had become reduced to 16 per cent each of lead and zinc with 11 ounces of silver to the ton. At present the average tenor is probably somewhat below those figures. In the effort to get rid of the zinc it was heaped up in enormous piles of zinc tailings and slimes from the concentrating plants, and lead concentrates with 20 per cent of zinc were smelted, lead slags averaging 16 per cent of zinc oxide with a maximum of 20 per cent having been run, according to Donald Clark.[1] Various leaching, electrolytic, and magnetic processes were successively tried and finally discarded for the flotation processes which have been in practical use since 1903. This method of concentration has the advantage that it can be applied to the current output of zinc tailings and slimes as well as to the accumulated stocks of those products.

In 1903 the department of mines of New South Wales estimated the tonnage of stored zinc tailings and other zincky residues at 5,687,400 long tons, containing an average of 18.6 per cent of zinc. In 1908 the stocks of zinc tailings were estimated by different authorities to amount to about 7,000,000 tons and to contain about 1,200,000 long tons of zinc, 350,000 tons of lead, and 40,000,000 ounces of silver. A correspondent of the Australian Mining Standard of April 6, 1910, puts the stock of tailings at 6,000,000 tons, the total capacity of the flotation plants when present plans are completed at about 31,000 tons weekly, and the current production of zinc tailings at 24,000 tons weekly. At this rate of excess of consumption over current production, it would require about 16 years for the re-treatment plants to absorb the accumulated tailings. This estimate is contingent upon the continuation in the future of the present rate of production of the mines.

At the Broken Hill Proprietary Co.'s Port Pirie zinc smelter, which when completed early in 1911 will have 10 furnaces and 1,440 retorts, 5 furnaces were finished and several hundred tons of spelter were made in trial runs.

An export duty on zinc concentrates, to encourage Australian zinc smelting and to obtain a measure of independence of European zinc smelters, is being agitated in New South Wales with fair prospects of adoption.

The following table compiled from the annual reports of the department of mines of New South Wales shows the quantity and zinc content of zinc concentrates exported from New South Wales from 1904 to 1910:

Exports of zinc (spelter and concentrates) from New South Wales, 1904–1910, in short tons.

Year.	Concentrates.	Zinc content.	Year.	Concentrates.	Zinc content.
1904	64,514	24,996	1908	309,044	127,515
1905	115,966	34,313	1909	418,775	161,300
1906	114,984	37,438	1910	524,862	207,085
1907	264,601	85,842			

[1] Clark, Donald; Australian mining and metallurgy, Melbourne, 1904, p. 372.

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METALLURGY.

CONCENTRATION AND SEPARATION.

FLOTATION METHODS.

A brief description of the various ore flotation processes was given in Mineral Resources for 1908, Part I, pp. 251–256, and to that summary the reader is referred for more detailed information. In the two years which have elapsed since that description was written, ore flotation has become the standard method of zinc concentration in Australia. The importance of flotation in that country is shown in the following table of the production of zinc concentrates at Broken Hill by flotation methods for the period 1907-1910, compiled from the annual reports of the department of mines of New South Wales. These concentrates are recovered from zinc middlings and tailings, both from the current product and from the stored accumulations of bygone years of milling operations. The minor quantities of lead concentrates recovered, as a table product from the zinc concentrates, are not included:

Production of zinc concentrates at Broken Hill, New South Wales, 1908–1910, in long tons.

Company.	Flotation process used.	1908		1909		1910	
		Tailings treated.	Concentrates.	Tailings treated.	Concentrates.	Tailings treated.	Concentrates.
Sulphide Corporation	Ballot	.....	98,000	.....	92,408	.....	80,401
Broken Hill Proprietary	Potter	276,703	64,373	171,172	52,042	279,150	69,855
Zinc Corporation	Elmore	131,965	45,707	227,502	84,698	270,637	85,625
Minerals Separation	Ballot	.....	32,197	193,842	62,022	240,143	79,288
Amalgamated Zinc (De Bavay's).	De Bavay	74,187	22,590	98,669	30,146	280,394	82,697
British Broken Hill	Elmore	.....	.....	.....	.....	33,428	9,622
Broken Hill Block 10	...do	.....	.....	.....	.....	3,300	965
Total concentrates produced.	.....	.....	262,867	.....	321,316	.....	397,866
Average zinc content	.....	.....	43.7 per cent.	.....	45 per cent.	.....	47.2 per cent.

Two new flotation processes, introduced into the Broken Hill district in 1909, were further developed during 1910. The Murex magnetic process takes advantage of the selective affinity of oils for sulphides of the metals rather than for the gangue minerals. The oils form the base of an adhesive liquid, with which is incorporated some magnetic substance in powdered form. This adhesive liquid is mixed with the pulp and the sulphides are thus agglomerated with the magnetic material. The separation from the gangue is accomplished by passing the mixed pulp beneath a magnet in water, the magnetic material and adhering sulphides being drawn to the magnet and carried away on an endless belt. A small plant has been erected at the Broken Hill Proprietary Block 14 Co.'s mine.

The Horwood process consists in giving the mixed sulphides a preliminary roast at a temperature between 300° and 400° C., in which the iron, copper, and lead sulphides are surficially changed to oxides and sulphates, but the zinc sulphide is unchanged. On treating the roasted material by the ordinary warm acid and oil flotation processes, the deadened surfaces of the oxidized sulphides are inert and only the

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zinc sulphide is floated. This process is especially suitable for the treatment of the slimes of the intimately mixed sulphides, yielding zinc concentrates without further table concentration. The remaining lead slime is available for direct smelting.

Ore flotation has made headway in Europe, but as yet its application in America is practically only experimental. Minerals Separation (Ltd.), of London, has organized an American branch under the title of Minerals Separation American Syndicate (Ltd.), for the purpose of forwarding the interests of that process in this country.

The Adelaide mill at Golconda, Nev., equipped with 100 MacQuisten flotation tubes and having a capacity of 125 tons daily, made a separation of chalcopyrite from a dense quartzose gangue with spinel and garnet, but it is not now in operation. A MacQuisten plant, consisting of 119 MacQuisten tubes, installed at the Morning mill of the Federal Mining & Smelting Co., at Mullan, Idaho, is successfully treating the zinc-barite-siderite middling from the tables and vanners. It is to be increased to 200 tons capacity, according to mining press reports.

The Elmore vacuum-oil flotation process is giving good results in one or two small installations in Mexico. It is reported that an Elmore flotation plant is being installed at the Wakefield mill on Four-Mile Creek in the Slocan district of British Columbia.

ELECTROSTATIC SEPARATION.

The first concentration plant equipped with the Huff electrostatic machines was that of the American Zinc Ore Separating Co., a subsidiary of the American Zinc, Lead, and Smelting Co., and owner of the rights of the separator as applied to the separation of zinc concentrates, the right of using the separator for concentrating other ores being still retained by the Huff Electrostatic Separator Co. This plant, completed in 1908 and located at Platteville, Wis., is of 100 tons daily capacity and is now equipped throughout with Huff machines, though in the original installation there were also Blake-Morscher machines. Working upon the zinc blende-marcasite ore of the upper Mississippi Valley region, the plant makes a 55 to 60 per cent zinc concentrate and a salable marcasite by-product.

The United States Smelting, Refining & Mining Co. is operating, in connection with the concentrating plant at Midvale, Utah, a 50-ton plant equipped with Huff electrostatic machines. The lead-zinc ores from the company's Bingham mines, treated in the concentration plant yield lead concentrates and middlings, the latter carrying 22 per cent zinc as well as some lead and pyrite. The middlings are passed through the Huff machines, yielding a 53 per cent zinc concentrate and a high-grade pyrite product carrying the gold, silver, and lead. The pyrite product is utilized at the lead smelter at Midvale. A separating plant employing the Huff machines will be added to the concentrating plant at Needles, Cal., of the Needles Mining & Smelting Co., a subsidiary of the United States Smelting, Refining & Mining Co. It is reported in the mining press that a Huff separating plant will be installed at Silverton, Colo., and another one at Butte, Mont.

A plant employing the Huff machines to effect a separation of zinc blende and chalcopyrite is under construction on the property of the Calumet & Sonora Mining Co. at Naco, Sonora, Mexico.

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ROASTING AND MAGNETIC SEPARATION.

Roasting and magnetic separation continues in favor for the separation of pyritic zinc ores. In Wisconsin a few years ago there were 25 or 30 such separating plants in operation at individual mines. With the erection of the electrostatic separator at Platteville and several custom magnetic separators it was considered more economical to sell the green ore to the custom separators. The capacity of the custom magnetic separators is being increased, notably the separating plant operated by the Mineral Point Zinc Co. There are now in operation and under construction seven such roasting and magnetic separating plants.

The Empire Zinc Co. of Colorado has a complete separating plant at Canon City, Colo., consisting of both wet and magnetic sections, the latter of which was greatly increased in capacity in 1910. Other new combined magnetic and wet concentration plants in Colorado are the mill of the American Zinc Extraction Co. at the mouth of the Yak tunnel, and the Wilson mill at Robinson, Colo.

The Basin Reduction Co. started a new 300-ton wet concentrator in Jefferson County, 28 miles from Butte, Mont., and the Grasselli Chemical Co. erected a 125-ton wet plant to treat tailings in the Park City district. The latter plant was in addition to the dry concentration plant already in operation by the company at that place.

SMELTING.

METALLURGICAL ADVANCE IN 1910.

The expense of the manual labor necessary in retort zinc smelting and the losses incident to the lack of continuity in that process have stimulated metallurgists to invent mechanical charging devices and to design forms of furnace in which the smelting operation should be continuous.

The Saeger cleaning and charging machines,[1] in use in the Silesian zinc works of Georg von Giesche's Heirs, consist of steel trucks operated by electricity upon tracks parallel to the face of the furnace. Mounted upon each truck in alignment with the sloping retorts are as many banks of screw conveyers as there are banks of retorts in the furnace, and from three to eight conveyers in each bank. After the condensers are removed, the cleaning machine withdraws the residues by inserting the screw conveyer into the retort; then follows the charging machine in which similar conveyers push the charge into the retort. The advantages of the machines are summed up as follows: Saving of half the labor charge; shortening of the injurious cooling-off period while cleaning and charging the furnaces, thereby increasing the time for distillation and consequently the yield; and lastly, more healthful conditions of work.

The Wettengel rotatable furnace,[2] is designed to save time and trouble in charging and cleaning the retorts. These are arranged in batteries in a revolving steel shell. They are turned upright beneath individual hoppers for charging, are revolved into a horizontal position for distillation, and lastly are turned downward for

[1] Metallurgie, Jan. 22, 1910: Translated in Eng. and Min. Jour., Apr. 9, 1910, pp. 780–781.
[2] Electrochem. and Metallurg. Ind., November, 1908, p. 457; April, 1911, pp. 198–201.

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discharging the residues. After recharging they are turned to the horizontal, 180 degrees from the position of first distillation. By thus alternating the top and the bottom of the retort its life is presumably doubled and the residues do not accumulate on one side. A small Wettengel furnace was in operation during 1910 at the works of the American Zinc, Lead & Smelting Co., at Caney, Kans., but the tests are not yet concluded and results are not available.

The Hughes revolving furnace [1] consists of a rotary retort held in place in a rotary shell or combustion chamber. A stack ore hopper feeds continuously into the upper end of the gently sloping retort, which discharges both zinc vapor and residues into a stationary cylindrical condenser at the lower end. Both the size and the temperature of the condenser are controllable. The waste heat of condensation is carried through the hopper, preheating the charge which arrives at the retort with a temperature of about 400° C. A retort 8 inches in diameter and 7 feet in length is shown by experience to have a capacity of about 5 tons of roasted zinc concentrates in 24 hours. Savings are claimed in handling the ore, in more efficient use of the heat, and in initial cost of plant. A small Hughes retort was given a trial test at Butte, Mont., in 1909–10, and a full commercial size retort is now installed at the demonstrating plant of the Hughes-West Continuous Zinc Distillation Co. at Southampton, a suburb of St. Louis, Mo.

Several methods have been proposed recently for smelting lead-zinc concentrates in the ordinary zinc furnace, producing lead-free spelter and lead-bearing residues suitable for lead smelting. One of these is the Hopkins process [2] which employs essentially a charcoal or carbon filter between the retort and the condenser. It is found in practice at Swansea that this process, working on Broken Hill zinc middlings, gave spelter 99.6 per cent pure as compared with 96.5 per cent pure with ordinary condensers, and at the same time gave a much better recovery of the zinc The increased recovery is due to the higher temperatures possible with this method. When the endeavor is also to raise the percentage of recovery, another charcoal or carbon filter is placed in the outer end of the condensers. In a 19-weeks test at Swansea, the Hopkins condensers and ordinary condensers working on opposite sides of the same furnace upon the same ore and in all other respects under the same conditions, the Hopkins condenser averaged more than 7 per cent greater recovery.

A process for smelting zinc-lead slimes and fine concentrates patented by Sulman and Picard, has been recently described.[3] The scheme was devised to treat the fine lead-zinc slimes resulting from the flotation processes at Broken Hill, New South Wales. This material could not be smelted profitably in the ordinary way because the lead destroyed the retorts and because the resulting spelter was too leady to be salable. In the experimental test the material was first carefully roasted in a hand roaster, then mixed and made into briquets composed of roasted ore, 70 per cent; bituminous coal, 25.5 per cent; and pitch, 4.5 per cent. The briquets were of such a size that 14 of them, 2 deep, just filled the retort. After dis-

[1] Mining World, July 10, 1910, p. 131.
[2] Trans. Institute of Metals, London, 1909. Reprinted in Mining Science, Mar. 3, 1910, pp. 198–200.
[3] Hoover, Theodore J., Smelting briquetted zinc ore: Eng. and Min. Jour., Aug. 13, 1910, pp. 323–324.

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tillation the briquets came out of the retorts quite porous, but intact, and well suited for direct lead smelting. There was no tendency for the retorts to "slag up" in the bottom because the briquets came away clear and entire each time. The recovery of zinc, based on the whole run, was 70 per cent, but at times it exceeded 85 per cent. The conclusion is that above 80 per cent recovery could be maintained in commercial operation, which is excellent practice for that class of ore. As results of this process, an otherwise unavailable product was rendered profitable, the spelter commanded a premium for purity, there was 33⅓ per cent increase in capacity of the retorts, and there was a considerable saving of time and waste in cleaning and recharging the retorts.

The problem of the complex lead-zinc ores has also been attacked from the electrochemical side. A 200-ton plant is under construction at Georgetown, Colo., by the Western Metals Co., which will employ the Malm process. In this process the sulphides are subjected to partial dry chlorination in a tube mill, the chloridizing is completed by agitation in a tank with hydrochloric acid, and the metals except zinc, are, by an emulsion of zinc oxide, precipitated in a form suitable, after filtering through asbestos filter presses, for treatment by lead smelters. The zinc chloride solution remaining is evaporated, fused, and electrolyzed, metallic zinc being thus recovered and the chlorine regenerated. The present plant is being constructed in the light of experience gained at the experimental plant previously in operation at Elkhorn, Mont. The Georgetown plant will not be completed until about the middle of 1911.

The occurrence of other metals in connection with zinc in ores offers no special difficulty in electrothermic zinc smelting. Reference is made on a later page to the official experimentation with electrothermic methods of zinc smelting now in progress in the Dominion of Canada. In the United States similar investigation is active. New forms of electric zinc furnaces have been brought out by Hixon (U. S. Patent No. 957,337, May 10, 1910), Woolsey McA. Johnson (U. S. Patent No. 964,268, July 12, 1910), and Fitzgerald. In the new Johnson furnace, the zinc vapors pass through a column of artificially heated coke before reaching the condensing chamber, with the object of completely reducing them and eliminating carbon dioxide, aqueous vapor, etc. The furnace described by Fitzgerald [1] was worked with satisfactory results at the Hohenlohehütte, Upper Silesia. This furnace employs a resistance arch of corrugated carbon plates and reduces the zinc sulphide by the Imbert method in a molten bath of ferric oxide and iron sulphide at a temperature of 1,000° C. to 1,100° C.

Other forms of electric furnace proposed for the reduction of zinc ores were briefly described in Mineral Resources for 1908, Part I, pages 262–264.

[1] Paper read at Fiftieth Anniversary of Massachusetts Institute of Technology.

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ZINC SMELTERS.

The following table gives the zinc-smelting capacity of the United States as determined by a recent canvass:

List of zinc smelters in the United States, showing capacity in 1910.

Company.	Location.	No. of roasting furnaces.	No. of zinc furnaces.	Number of retorts.
American Zinc, Lead & Smelting Co.	Caney, Kans.	3	12	3,648
Do.	Dearing, Kans.	3	12	3,840
Bartlesville Zinc Co.	Bartlesville, Okla.	4	14	4,608
Bertha Mineral Co.	Pulaski, Va.	.....	10	1,400
Chanute Zinc Co.	Chanute, Kans.	2	4	1,280
Collinsville Zinc Co.	Collinsville, Ill.	4	12	1,528
Edgar Zinc Co.	Cherryvale, Kans.	8	24	4,800
Do.	St. Louis, Mo.	5	9	2,016
Granby Mining and Smelting Co.	Neodesha, Kans.	3	12	3,840
Grasselli Chemical Co.	Clarksburg, W. Va.	.....	10	5,760
Hegeler Bros.	Danville, Ill.	1A	2	1,800
Illinois Zinc Co.	Peru, Ill.	5A	7	4,640
Kansas [Cockerill] Zinc Co. (leased to Beer, Sondheimer & Co.).	Altoona, Kans.	3	6	3,840
Kansas [Cockerill] Zinc Co. (leased to L. Vogelstein & Co.).	Gas City, Kans.	2	4	2,520
Do.	La Harpe, Kans.	4	3	1,856
Kansas [Cockerill] Zinc Co.	Pittsburg, Kans.	4	6	1,344
Do.	Bruce, Kans.	4	4	896
Do.	Nevada, Mo.	3	3	672
Lanyon-Starr Smelting Co.	Bartlesville, Okla.	2	12	3,456
Lanyon Zinc Co., No. 1 (leased to American Metal Co.).	Iola, Kans.	2	10	3,340
Lanyon Zinc Co., No. 2 (leased to American Metal Co.).	.....do.....	3	10	3,320
Lanyon Zinc Co., No. 3 (leased to American Metal Co.).	La Harpe, Kans.	4	10	3,200
Matthiessen & Hegeler Zinc Co.	Lasalle, Ill.	3A	5	4,380
Mineral Point Zinc Co.	Depue, Ill.	2A	6	4,520
National Zinc Co.	Bartlesville, Okla.	3	10	3,040
New Jersey Zinc Co (of Pa.)	South Bethlehem, Pa.	.....	18	1,620
Do.	Palmerton, Pa.	.....	14	2,918
Pittsburg Zinc Co.	Pittsburg, Kans.	6	8	910
Prime Western Spelter Co	Iola, Kans.	3	10	3,240
Do.	Gas City, Kans.	8	18	5,340
Sandoval Zinc Co.	Sandoval, Ill.	2	8	996
United States Zinc Co.	Pueblo, Colo.	6	7	1,680
United Zinc and Chemical Co.	Springfield, Ill.	.....	4	2,080
Total		102	304	94,328
Total maximum smelting capacity, short tons.		.....	.....	400,681
Total effective smelting capacity, short tons.		.....	.....	375,000

Zinc-smelting capacity of the United States, by States, in 1910.

State.	Number of retorts.	State.	Number of retorts.
Colorado	1,680	Pennsylvania	4,538
Illinois	19,944	Virginia	1,400
Kansas	47,214	West Virginia	5,760
Missouri	2,688		
Oklahoma	11,104	Total	94,328

The total maximum annual smelting capacity of the 94,328 retorts of the plants listed above is 400,681 short tons. Several of the plants have not been operated for several years, and they are probably abandoned. Certain of the smelters regularly redistill considerable quantities of zinc skimmings and other secondary material, and a proportionate part should be deducted from their

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primary smelting capacity, that is, their capacity for smelting ore. About 6,000 retorts, with an output of 25,500 tons of spelter, should therefore be taken from the maximum capacity, leaving 88,328 retorts and about 375,000 tons as the effective smelting capacity.

Those plants which have an "A" opposite the number of roasting furnaces operate, in addition, sulphuric-acid plants. The Grasselli Chemical Co. operates acid plants in connection with its zinc-roasting furnaces at Grasselli, Ind., and Cleveland, Ohio, the roasted zinc concentrates being shipped to the zinc smelter at Clarksburg. The United Zinc & Chemical Co. has zinc-roasting furnaces at Argentine, Kans., where the sulphur gases are utilized in an acid plant, the roasted concentrates being shipped to the smelter at Springfield, Ill.

NEW ZINC SMELTERS.

The following is a list of proposed new zinc smelters. They are all actually under construction, with the exception of the plant of the Granby Mining & Smelting Co., which it is reported will be started in the early part of 1912. Those smelters with "A" in the zinc-furnace column will manufacture sulphuric acid also.

List of new zinc smelters under construction in 1910.

Company.	Location.	Completed.	Number of zinc furnaces.	Number of retorts.
American Zinc, Lead & Smelting Co.	Hillsboro, Ill.	1912	10 A	4,000
Bartlesville Zinc Co.	Collinsville, Okla.	1912	8	3,200
Granby Mining & Smelting Co.	East St. Louis, Ill.	1914	6 A	2,880
Grasselli Chemical Co.	Meadowbrook, W. Va.	1911	8 A	2,280
Robert Lanyon Zinc & Acid Co.	Hillsboro, Ill.	1912	4 A	1,600
Tulsa Fuel & Manufacturing Co. (subsidiary of Prime Western Spelter Co.).	Collinsville, Okla.	1912	10	4,680

CHANGES IN 1910.

An important feature of the year was the further acquisition of zinc-mining land by several zinc-smelting companies. The New Jersey Zinc Co., in addition to the famous Franklin Furnace and Sterling Hill mines of New Jersey, has, through its subsidiaries, the Empire Zinc Co. and the Empire Zinc Co. of Colorado, for many years had extensive interests in zinc-mining lands in Missouri, Colorado, and other Western States. An affiliation, the Mineral Point Zinc Co., has in the last year or two largely increased the operations and holdings of its mines department in the Wisconsin field. The American Zinc, Lead, & Smelting Co. was engaged in zinc mining before it became interested in smelting; but recently its holdings of productive lands in the Joplin region have been largely increased—as have been the holdings of its subsidiary, the Wisconsin Zinc Co., in the upper Mississippi Valley region. The Granby Mining & Smelting Co. has large tracts of productive territory in the Joplin region which it has heretofore operated on the subleasing basis, but within the year the company has engaged in active mining. The Grasselli Chemical Co. has lately acquired important zinc lands in eastern Tennessee. The American Metal Co., through an affiliated company, has for years held zinc lands in the Joplin region, and is

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reported by the mining press to have recently purchased zinc properties in Western States. Several other smelting companies have been and are still interested in zinc-mining lands on a smaller scale than the foregoing.

The Cockerill Zinc Co. failed early in February. The business was reorganized and continued by the bondholders as the Kansas Zinc Co., and later the Altoona smelter was leased to Beer, Sondheimer & Co. and the Gas City and La Harpe plants were leased to L. Vogelstein & Co. The receivership of the Lanyon Zinc Co. was dissolved in September, but the plants had been operated during the year under lease to the American Metal Co.

In the latter part of 1910 the two plants of the United Zinc & Chemical Co. at Iola, Kans., were dismantled, a part of the equipment being moved to the plant at Springfield, Ill., and the remainder was purchased for use in the new Lanyon smelter at Hillsboro, Ill. The smelter at Rich Hill, Mo., is reported as dismantled. The smelter at Wenona, Ill., is probably abandoned, and is therefore dropped from the list. The plant of the New Jersey Zinc Co. at South Bethlehem was closed down in midyear and will probably not be operated again. Numerous additions to smelting capacity were made during the year, so that on the whole there was a net loss of but 606 retorts in smelting capacity.

The following lists show the plants abandoned and the additions to smelting capacity in 1910:

Plants dismantled or abandoned in 1910.

Company.	Location.	Number of retorts.
Cockerill Zinc Co.	Rich Hill, Mo.	672
New Jersey Zinc Co.	South Bethlehem, Pa.	1,620
United Zinc & Chemical Co.	Iola, Kans.	2,624
Wenona Zinc Works.	Wenona, Ill.	512
Total.		5,428

Additions to smelting capacity in 1910.

Company.	Location.	Number of retorts.
Bartlesville Zinc Co.	Bartlesville, Okla.	1,152
Lanyon-Starr Smelting Co.	do.	1,152
Mineral Point Zinc Co.	Depue, Ill.	760
National Zinc Co.	Bartlesville, Okla.	608
New Jersey Zinc Co.	Palmerton, Pa.	350
United Zinc & Chemical Co.	Springfield, Ill.	800
Total.		4,822

CHANGES IN 1911.

It is possible to forecast with fair certainty the changes in smelting capacity during 1911. The plants of the Lanyon Zinc Smelting Co. are being dismantled, the equipment from the works at Iola going into the smelter of the Bartlesville Zinc Co. at Collinsville, Okla., and that from the La Harpe works being used in the Robert Lanyon smelter at Hillsboro, Ill. The zinc-rolling mill at the La Harpe

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plant was purchased by Ball Bros. Glass Manufacturing Co. and is now being operated by the La Harpe Zinc Rolling Mill Co., with an output of 5 tons daily of long strips suitable for making can lids. The Bertha Mineral Co. has closed down and partly dismantled its smelter at Pulaski, Va.

Large increases in retort capacity are under construction at the Palmerton, Pa., plant of the New Jersey Zinc Co., and at the works of the United Zinc & Chemical Co., at Springfield, Ill. The Grasselli Chemical Co. early in the year completed a smelter at Meadowbrook, W. Va., which was started up in March. The roasting furnaces are located at Newcastle, Pa., where sulphuric acid is made, the roasted concentrates being shipped to Meadowbrook for smelting. The net decrease in retort capacity for 1911 will probably be about 4,500 retorts, though this may be partly offset by additions not as yet announced.

Zinc smelters dismantled or abandoned in 1911.

Company.	Location.	No. of retorts.
Bertha Mineral Co	Pulaski, Va	1,400
Lanyon Zinc Smelting Co	Iola and La Harpe, Kans.	9,860
Total		11,260

Additions to smelting capacity in 1911.

Company.	Location.	No. of retorts.
Grasselli Chemical Co	Meadowbrook, W. Va.	2,280
New Jersey Zinc Co	Palmerton, Pa	2,880
United Zinc and Chemical Co	Springfield, Ill	1,600
Total		6,760

CHANGES IN 1912.

In 1912, as at present planned, new smelters aggregating 13,480 retorts will be completed and there will doubtless be additions to other smelters. On the other hand the year will probably witness the closing of some smelters now in operation.

Smelting capacity to be added in 1912.

Company.	Location.	No. of retorts.
American Zinc, Lead, & Smelting Co	Hillsboro, Ill	4,000
Bartlesville Zinc Co	Collinsville, Okla.	3,200
Robert Lanyon Zinc and Acid Co	Hillsboro, Ill	1,600
Tulsa Fuel and Manufacturing Co	Collinsville, Okla.	4,680
Total		13,480

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ZINC PIGMENT PLANTS.

The following is a list of the plants which produced zinc oxide or zinc-lead oxide in the United States in 1910:

List of active zinc oxide and zinc-lead oxide plants in the United States in 1910.

Bertha Mineral Company, Austinville, Va.
Mineral Point Zinc Company, Mineral Point, Wis.
New Jersey Zinc Company, Newark, N. J.
New Jersey Zinc Company (of Pennsylvania), Freemansburg, Pa.
New Jersey Zinc Company (of Pennsylvania), Palmerton, Pa.
New Jersey Zinc Company (of Pennsylvania), South Bethlehem, Pa.
Ozark Smelting and Mining Company, Coffeyville, Kans.

The oxide plant of the Empire Zinc Co. at West Plains, Mo., has not been operated for some years; the plant of the Ozark Smelting and Mining Co. at Joplin, Mo., has been idle since 1907; and the zinc-lead oxide works of the United States Smelting Co. at Canon City, Colo., were closed down in July, 1909, and have since been partly dismantled.

The small oxide plant of the Bertha Mineral Co. at Austinville is described by Watson as follows:[1]

This plant, consisting of 12 furnaces, has only recently been added for the purpose of utilizing the low-grade ore and tailings, which were formerly discarded. The grade of ore, including tailings, used for making the oxide will average from 15 to 20 per cent metallic zinc. The zinc oxide made is sent to the Pulaski furnaces where it is used for making spelter. The oxide made is white, and contains about 4 per cent of lead, and averages from 70 to 80 per cent of metallic zinc. The successful operation of this plant at Austinville is of great importance, since it furnishes a ready method for utilizing low-grade zinc ores, which have elsewhere been claimed not to be profitable for making spelter.

Now that the Bertha smelter at Pulaski has been abandoned, the oxide plant will continue to operate upon the low-grade Austinville ore and tailings, the product being marketed in part at least as zinc oxide.

The Mineral Point Zinc Co. has had oxide and acid plants and magnetic separation works at Mineral Point for many years. In 1907 the acid plant was discontinued, but in 1910 a new oxide plant was erected beside the old one which will be dismantled when the new plant is started up, about July, 1911. The new plant has 4 blocks of 12 furnaces each, 48 furnaces in all, as compared with 36 similar furnaces in the old plant, and the bag-house capacity has been proportionately increased. The steel and concrete storage bins, holding 30,000 tons of ore, the mixing rooms, and the furnaces are under one roof. An overhead traveler serves the bins and the mixing room, and a trolley over each block of furnaces drops the charge through a hole in the top of the furnace. The increased furnace capacity and the improved mechanical appliances will add 50 per cent to the output of the plant without additional labor cost. The covered storage bins will be of great advantage in the winter operation of the plant.

The oxide plant of the New Jersey Zinc Co. at South Bethlehem, Pa., will be closed down and abandoned along with the zinc smelter at that place, but the production will be taken care of by the oxide plant at Palmerton, the capacity of which is being largely increased.

[1] Watson, Thos. L., Mineral resources of Virginia, Lynchburg, 1907, p. 546.

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TRADE CONDITIONS.

WORLD'S PRODUCTION.

The world's production of spelter in 1910 was again the largest in history, exceeding that of the record output of 1909 by 35,104 short tons, or 4.1 per cent. The major part of this increase was contributed by the United States, which exceeded its production of 1909 by 13,424 tons, or 5.2 per cent. Good gains were also made by Belgium, France, Spain, and the Rhine district, and smaller gains by other countries, no country failing to show some increase. The output of the United States was 30.5 per cent of the total production of the world. The next largest producers were Germany, with 27.33 per cent of the world's production to her credit, and Belgium with 21.53 per cent.

The following totals, apportioned according to the country where smelted and not according to the source of the ore, are taken from the annual statistical publication for 1910 of the Metallgesellschaft, the Metallurgische Gesellschaft, A.-G., and the Berg- und Metallbank Aktiengesellschaft, of Frankfurt-am-Main, Germany:

The world's production of spelter, 1904–1910, by countries, in short tons.

Country.	1904	1905	1906	1907	1908	1909	1910
Australia	.....	.....	1,131	1,098	1,198	.....	560
Austria and Italy	10,192	10,315	11,883	12,522	14,063	13,931	14,666
Belgium	154,314	160,496	168,067	170,307	181,851	184,194	190,233
France and Spain	54,107	55,524	59,293	61,438	61,512	61,859	65,191
Germany:							
Rhine district	72,083	74,127	75,729	77,459	80,670	82,863	86,823
Silesia	138,538	143,243	150,282	152,401	154,524	153,990	154,596
Great Britain	50,949	56,140	57,971	61,286	60,029	65,422	69,531
Holland	14,442	15,176	16,150	16,526	19,017	21,548	23,121
Poland	11,693	8,422	10,595	10,735	9,740	8,758	9,514
United States	186,704	203,849	224,770	249,860	210,424	255,760	269,184
Total	693,022	727,292	775,871	813,632	793,028	848,315	883,419
United States percentage of world's production	26.9	28.0	28.9	30.7	26.5	30.1	30.5

PRODUCTION OF SECONDARY SPELTER IN EUROPE.

The following table of the production of secondary spelter in Europe is calculated to short tons from a table published by Rudolf Wolff, Kreuger & Co., of London. It includes the output of the larger regular producers only. The production of the United States is included for comparison:

Production of secondary spelter in Europe and United States, 1905–1910, in short tons.

Country.	1905	1906	1907	1908	1909	1910
Austria-Hungary	3,505	3,674	3,931	3,315	3,102	2,934
Belgium	4,044	4,473	3,620	4,295	3,564	3,406
France	14,304	14,898	15,130	20,309	20,467	20,691
Germany	9,689	11,040	11,316	13,273	14,943	15,133
Great Britain	7,913	7,644	7,168	8,714	8,454	7,605
Holland	2,268	2,800	2,957	2,923	2,184	2,610
Russia	1,680	.....	1,680	1,680	.....	224
United States	.....	.....	18,841	16,970	33,040	41,223
Total	43,403	44,529	64,643	71,479	85,754	93,826

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IMPORTS AND EXPORTS.

WAREHOUSE TRANSACTIONS.

Zinc imported into the United States as metal or in ore may be entered for immediate consumption, in which case the duty is paid and the zinc goes direct to the consumer; or it may be entered for warehouse, bond being given for double the amount of the estimated duty. From warehouse the zinc may be withdrawn for consumption by payment of duty, or it may be smelted in bond, finally being either withdrawn for consumption or exported from warehouse with cancellation of bond. The zinc entered for immediate consumption and that withdrawn from warehouse for consumption make up the table below of imports for consumption which are expressed in the same terms in which they were imported. The zinc imported for consumption may be actually used in the country or it may be manufactured and exported, in which case the manufacturer is entitled to the benefit of a drawback of 99 per cent of the duties paid. In the table below showing foreign zinc exported in manufactures with benefit of drawback, the zinc is shown in the form in which it was originally imported. On account of diversity of form it is not feasible to show the articles exported with benefit of drawback. The foreign zinc given in the table below as exported from warehouse is likewise shown in the form in which it was imported and entered for warehouse. A somewhat more detailed explanation of warehouse transactions is given in the chapter on lead in this volume. The following tables of imports and exports of zinc and of zinc remaining in warehouse are made up from the publications and records of the Bureau of Statistics.

The quantity of zinc remaining in warehouse at the close of the years previous to 1909 has been negligible, but since all zinc ore became dutiable on August 6, 1909, the quantity of bonded zinc has largely increased.

Practically all the zinc remaining in warehouse as shown in the table below is credited to the port of Kansas City, Mo., and is in possession of the bonded zinc smelters of Kansas and Oklahoma.

Zinc remaining in warehouse, Dec. 31, 1909–10.

Year.	Ore and calamine.			Blocks, pigs, and old.	
	Short tons.	Zinc content.	Value.	Quantity.	Value.
		Pounds.		*Pounds.*	
1909	2,813	2,265,341	$36,384	78,667	$4,021
1910	2,603	2,572,122	61,730	61,146	3,406

The figures for 1910 are exclusive of 2,627,939 pounds of zinc contained in 10,359 tons of lead ore entered at New York, and valued at $131,397, which zinc is lost in smelting the lead, as explained later in the discussion of the general imports of zinc ore.

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IMPORTS.

Zinc imported and entered for consumption in the United States, 1902–1910, in short tons.

Year.	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1902	448	$36,536	68	$8,339	157	$8,299	$32,708	$85.882
1903	202	19,161	129	8,537	163	11,772	10,376	49,846
1904	341	34,211	17	2,230	36	3,247	10,394	50,082
1905	428	46,295	14	1,953	86	5,110	8,253	61,611
1906	1,021	240,632	22	3,236	79	7,647	2,904	254,419
1907	1,709	220,474	52	7,158	122	8,582	8,516	244,730
1908	776	78,160	37	4,570	37	2,014	5,645	90,389
1909	9,419	805,087	117	13,510	238	9,999	6,488	835,084
1910	989	95,410	255	36,741	73	5,685	1,526	139,362

The foregoing figures are exclusive of the quantity and value of zinc dust imported for consumption. Prior to August 6, 1909, zinc dust was entered free of duty under "articles in a crude state used in dyeing and tanning," and as such was not separately enumerated by the Bureau of Statistics. Since the date mentioned, zinc dust bears a duty of 1⅛ cents per pound, and is separately enumerated under "imports for consumption," though included with spelter in the Monthly Summary of general imports. The imports for consumption of zinc dust for the period August 6 to December 31, 1909, were 431,660 pounds, valued at $19,464. This quantity and value is included in the total for the year as given in the table below. The quantity of zinc dust imported for consumption in 1910 and its value are also as given in the table. The only statistics available for the time before August 6, 1909, are those of foreign countries relating to their exports of zinc dust to the United States. Among these countries are Germany, Belgium, France, Holland, and Denmark, but only in the reports of the first-mentioned country are the exports of zinc dust segregated from other exports. Germany furnishes much the larger part, amounting to about 95 per cent of the total imports of zinc dust; for this reason the zinc dust exports from Germany to the United States from March 1, 1906, to August 5, 1909, inclusive, as compiled from the annual Statistik des Deutschen Reichs, Auswärtiger Händel, and shown in the following table, give a fair idea of the total consumption of zinc dust in the United States for that period.

Imports of zinc dust, 1906–1910, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1906[a]	1,818,576	$108,052	1909	2,520,740	$130,662
1907	1,893,090	106,386	1910	2,985,068	136,749
1908	2,625,238	136,136			

[a] March–December, 1906; for period preceding, zinc dust is not separately enumerated.

In view of the general interest in the importation of zinc ores, a table is given below, showing the entry of such ores from Mexico and Canada for 1904–1910 by calendar years. These general imports of zinc ores differ from "imports for consumption" by the difference in stock in bonded warehouse at the beginning and close of the year.

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The statistics of general imports as published by the Bureau of Statistics are based on "consular invoice" or "declaration," which is a close approximation only to actual weights and values. The true weights and values of all dutiable articles are determined when the duties are paid, and the correction is applied as "additions by liquidation" or "deductions by liquidation." On free articles this correction is not made. Prior to 1909 zinc ore was in large part undutiable, and in that part of 1909 prior to August 6 a portion of the imports of zinc ore was free. The correction by liquidation for the dutiable zinc ore imported during 1909–10 is shown in the table. Inasmuch as this correction takes the form of "addition," it shows that the actual imports of zinc ore for preceding years exceed the figures in the table by an unknown quantity. Beginning with August 6, 1909, the corrections by liquidation apply to the total imports, thereby giving exact figures of such imports.

General imports of zinc ore from Canada and Mexico, 1904–1910, in short tons.

	Canada.		Mexico.		Total.	
	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.
1904			2,264		2,264	
1905	4,063		18,074		22,137	
1906	423		59,991		55,414	
1907	1,112		102,005		103,117	
1908	7,406		46,351		53,757	
1909	10,024		104,826 [a] + 1,419		116,269	
1910	4,749	1,922	67,818 [a] +14,839	23,517 [a] +16,917	[b] 87,406	[b] 42,356
Grand total, 1904-1910					440,364	

[a] Plus sign (+) indicates "addition by liquidation."
[b] Exclusive of 822 short tons of zinc ore, valued at $689 and containing 31,889 pounds of zinc which entered free of duty as containing less than 10 per cent of zinc.

The foregoing figures of imports of zinc ore in 1910 are exclusive of 10,431 short tons of lead ore which carried 2,645,111 pounds of zinc as an accessory constituent, an average of less than 13 per cent, which was lost in smelting the lead and hence for the purpose of this report not to be classed with zinc ore imports so long as the present metallurgical treatment of that ore obtains. This ore was shipped from South American ports and largely entered through the port of New York. It is shown in the Monthly Summary of the Bureau of Statistics under the heading of "Merchandise remaining in warehouse," mostly at New York. Later on in this chapter under the heading "Customs duties on zinc" mention is made of recent customs litigation in regard to ores bearing more than one dutiable metal.

Zinc oxide imported and entered for consumption, 1901–1910, in short tons.

Year.	Dry.	In oil.	Year.	Dry.	In oil.
1901	1,800	64	1906	2,096	146
1902	1,636	82	1907	2,656	181
1903	1,744	83	1908	2,318	105
1904	1,293	112	1909	3,060	268
1905	1,718	171	1910	3,069	168

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Imports of old brass fit only for remanufacture, 1903–1910, in pounds.

[Average composition about one-third zinc and two-thirds copper.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1903	1,216,663	$154,200	1908	2,714,155	$355,335
1904	2,559,054	310,311	1909	4,672,575	579,454
1905	9,676,798	1,169,330	1910	6,144,564	785,684
1906	12,938,205	1,991,126			
1907	7,957,015	1,344,753	Total	47,979,049	6,590,243

EXPORTS.

DOMESTIC EXPORTS.

The practice of the Bureau of Statistics is to class all exports of zinc articles made in this country as domestic exports, whether the zinc be of domestic or foreign origin. Hence the following table of domestic exports is duplicated in part in a later table of foreign zinc in manufactures exported with benefit of drawback. The exports of zinc ore in the table below are of domestic origin and in recent years have all been from one mine in New Jersey. The exports of plates, sheets, pigs, or bars are likewise probably wholly domestic, since as shown later all the zinc in manufactures going out under drawback came in as blocks, pigs, and sheets, and the only manufacturing process which would put any of these into the class of exports referred to is rolling into sheets. But the zinc rolling mills in this country do not use foreign spelter, hence the conclusion that the plates, sheets, pigs, and bars of the table are of domestic origin. The zinc dross exports are no doubt in part of foreign origin, but in what proportion can not be determined. However, they are not duplicated in the drawback table. The exports of manufactures, of which the value is given, include the value of the whole of the manufactures exported with benefit of drawback, as well as whatever manufactures of domestic zinc may be exported.

Exports of domestic zinc ore and of domestic manufactures of zinc, 1902–1910, in short tons.

Year.	Zinc ore.		Plates, sheets, pigs, or bars.		Zinc dross.[a]		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1902	55,733	$1,449,104	3,237	$300,557	.....	.....	$114,197	$1,863,858
1903	39,411	987,000	1,521	162,379	.....	.....	71,354	1,221,733
1904	35,911	905,782	10,147	1,094,490	.....	.....	117,957	2,118,229
1905	30,946	843,451	5,516	682,254	.....	.....	159,995	1,690,700
1906	27,720	733,300	4,670	583,526	15,887	$1,103,706	204,269	2,624,801
1907	[b] 20,352	579,490	563	75,194	9,583	560,944	186,203	1,401,831
1908	[b] 26,108	877,745	2,640	250,254	8,405	467,403	88,485	1,683,887
1909	[b] 12,455	412,300	2,566	263,010	7,069	477,112	69,751	1,222,173
1910	[b] 19,711	649,425	3,990	426,360	4,724	330,950	101,336	1,508,271

[a] Not separately enumerated prior to 1906.
[b] The exports consisted wholly of high-grade willemite ore from New Jersey.

Exports of zinc oxide, 1902–1910, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	5,358	$433,722	1907	13,257	$1,069,924
1903	7,215	578,215	1908	12,008	845,070
1904	8,157	628,494	1909	14,846	1,026,377
1905	11,200	810,208	1910	13,167	943,968
1906	15,578	1,149,297			

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FOREIGN EXPORTS.

By foreign zinc exports is meant the exports of zinc of foreign origin which has been smelted or manufactured in this country and then shipped abroad. The following table, made up from the records of the Bureau of Statistics, shows the total zinc exported from warehouse during the last six years, the exports previous to that period being of insignificant proportions, and also the foreign zinc exported in manufactures with benefit of drawback for the same period. These two items, foreign zinc exported from warehouse and foreign zinc in manufactures exported with benefit of drawback, make up the total foreign zinc going out of the country. Zinc in warehouse and deductions by liquidation being disregarded, the difference between the sum of these two exports of zinc and the total imports of zinc constitutes the foreign zinc consumed in this country. It must be clearly understood in regard to this table that the zinc was not exported as zinc content of ore and blocks, pigs, etc., but as zinc smelted or manufactured from them. The reason for this is that the zinc in bonded customs warehouse is carried on the records until the bond is canceled in the same form in which the zinc was entered for warehouse. The zinc content of the foreign ore is, of course, exported as spelter. Under present customs regulations 90 per cent of the total zinc content must be exported to secure cancellation of bond. The quantities of zinc exported from warehouse are exact, but the quantities as given of zinc exported in manufactures under drawback are subject to wastage in manufacturing.

There is no record kept of the form in which the zinc is actually exported, except in case of a portion of the articles manufactured from foreign zinc and exported with benefit of drawback. Unless the zinc be the constituent of chief value, the actual amount of zinc is not recorded. But each shipment on which drawback is claimed is accompanied by a manifest of the imported zinc which was used in making the articles as well as the duty paid thereon. From these manifests is made up the statement of the total quantity of foreign zinc which went into manufactures exported with benefit of drawback, and for this reason the zinc is given in the form in which it was imported.

Exports of foreign zinc, 1905–1910, in pounds.

Year.	Exported from warehouse.					Exported in manufactures with benefit of drawback.
	Ore and calamine, zinc content. [a]		Blocks, pigs, and old.		All other manufactures.	Blocks, pigs, sheets, and all other manufactures.
	Quantity.	Value.	Quantity.	Value.	Value.	Quantity.
1905	.....	.....	36,753	$816	$1,015	.....
1906	.....	.....	2,779	252	1,902	4,469
1907	.....	.....	17,458	1,023	1,504	3,110,239
1908	.....	.....	16,748	964	4,636	2,468,365
1909	[a] 655,102	$6,429	12,569	752	521	610
1910	[a] 9,420,984	182,345	94,672	4,884	1,121	8,972,427

[a] After August 6, 1909.

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CUSTOMS DUTIES ON ZINC.

The tariff act of 1909, effective August 6, has the following sections relating to zinc ore, zinc, and to compounds containing zinc:

PAR. 55. Zinc, oxide of, and white pigment containing zinc, but not containing lead, dry, one cent per pound; ground in oil, one and three-fourths cents per pound; sulfid of zinc, white, or white sulphide of zinc, one and one-fourth cents per pound; chloride of zinc and sulphate of zinc, one cent per pound.

PAR. 193. Zinc-bearing ore of all kinds, including calamine, containing less than ten per centum of zinc, shall be admitted free of duty; containing ten per centum or more of zinc, and less than twenty per centum, one-fourth of one cent per pound on the zinc contained therein; containing twenty per centum or more of zinc and less than twenty-five per centum, one-half of one cent per pound on the zinc contained therein; containing twenty-five centum of zinc, or more, one cent per pound on the zinc contained therein: *Provided*, That on all importations of zinc-bearing ores the duties shall be estimated at the port of entry, and a bond given in double the amount of such estimated duties for the transportation of the ores by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the samples thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample, and report the result to the proper customs officers, and the import entries shall be liquidated thereon, except in case of ores that shall be removed to a bonded warehouse to be refined for exportation as provided by law. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

PAR. 194. Zinc in blocks or pigs and zinc dust, one and three-eighths cents per pound; in sheets, one and five-eighths cents per pound; in sheets coated or plated with nickel or other metal or solutions, one and three-fourths cents per pound; old and worn-out, fit only to be remanufactured, one cent per pound.

Section 24 of the tariff act of 1909 provides for the establishment of bonded smelting warehouses for smelting or refining in bond of ores and crude metals, but makes provision for the withdrawal from same of lead alone. Upon application of the United States Zinc Co. the Treasury Department made the following ruling (T. D. 30015):

TREASURY DEPARTMENT, *September 29, 1909.*

SIR: In a letter dated the 24th instant the department confirmed its telegram of the same date approving the application of the United States Zinc Co. to bond as a warehouse of class 7 its works at Pueblo, Colo., for the smelting and refining of imported ores.

As it appears from correspondence with this company that the works have been bonded for the smelting of zinc ores and the exportation of the refined metal, I have to advise you that there is no provision in the tariff act of August 5, 1909, for the remission of duty upon zinc withdrawn for exportation from a bonded smelter, as section 24 of this act provides only for the exportation of lead from bonded smelters. Scetion 29 of the tariff act July 24, 1897, provides for the bonding of the works of manufacturers engaged in smelting or refining metals, or both smelting and refining, and for the cancellation of the bonds for the payment of the duty upon the exportation of 90 per cent of the metals smelted or refined.

In the opinion of the department there is nothing inconsistent in the provisions of the two acts in so far as they relate to metals other than lead, and it therefore construes section 29 of the act of July 24, 1897, as remaining in force to this extent, and you are therefore authorized to permit the zinc to be withdrawn from the United States Zinc Co.'s works, located at Pueblo, as provided therein—that is, the bond given for the exportation of the refined zinc should be canceled upon the exportation of 90 per cent of the zinc as shown by the assay to be in the imported ore and so charged against the bond.

Respectfully,

CHARLES D. NORTON,
Acting Secretary.

SURVEYOR OF CUSTOMS, *Denver, Colo.*

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The following zinc smelters have been established as bonded smelting warehouses for the treatment of foreign zinc ore and as such are entitled to the cancellation of the bond on importations of such ore upon the exportation of 90 per cent of the zinc content and all of the recovered lead content of such ores:

List of bonded zinc smelters, 1910.

Lanyon Zinc Co., Iola and La Harpe, Kans.
Prime Western Spelter Co., Gas and Iola, Kans.
A. B. Cockerill, Nevada and Rich Hill, Mo.
Cockerill Zinc Co., Altoona and Pittsburg, Kans.
Wm. Lanyon, Iola and Pittsburg, Kans.
La Harpe Smelting Co., La Harpe, Kans.
Bartlesville Zinc Co., Bartlesville, Okla.
National Zinc Co., Bartlesville, Okla.
Altoona Zinc Works, Altoona, Kans.
American Metal Co. (lead), La Harpe, Kans.
United States Zinc Co., Pueblo, Colo.

The Consolidated Kansas City Smelting & Refining Co. protested against the assessment of duty by the collector of customs at the port of El Paso upon both the lead and the zinc contents of ore, the importers claiming that either metal was lost in the attempt to recover the other. The Board of Appraisers, June 27, 1910, rendered a decision (T. D. 30727) affirming the act of the collector. The importers appealed to the United States Court of Customs Appeals, the decision of which affirmed that of the Board of Appraisers.

CONSUMPTION.

In the following tables, showing the consumption of spelter in the United States and in the world for the period 1898–1910, the figures of foreign consumption are computed from statistics published by the Metallgesellschaft, etc., for 1910. In those statistics consumption is calculated on the basis of production plus excess of imports over exports or minus excess of exports over imports, and altogether disregards smelter stocks. For the sake of comparison, the consumption of the United States is calculated by both methods. Although in the long run the stocks carried over from one year are consumed in the next and thus are equalized, it can not be gainsaid that for the individual year to take stocks into account gives greater accuracy. To obtain perfectly accurate figures of consumption it would be necessary to consider the stocks in the hands of consumers and dealers and to take into account the secondary spelter consumed.

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Consumption of primary spelter in the United States, 1907–1910, in short tons.

	1907	1908	1909	1910
Supply:				
Stock January 1—				
In bonded warehouses	.....	2	9	39
At smelters	3,324	26,364	19,613	11,167
Production	249,860	210,424	255,760	269,184
Imports	1,778	881	9,454	1,960
Total available	255,462	237,671	284,836	282,350
Withdrawn:				
Exports, foreign, from warehouse	9	8	334	4,758
Exports, foreign, under drawback	1,355	1,234	.....	4,486
Exports, domestic	563	2,640	2,556	3,990
Stock, December 31—				
In bonded warehouses	2	9	39	31
At smelters	26,364	19,613	11,167	23,201
Total withdrawn	28,493	23,504	14,106	36,466
Apparent consumption	226,969	214,167	270,730	245,884

In considering the consumption of primary spelter there should be borne in mind the rapidly increasing quantity of secondary material, such as zinc skimmings, ashes, hard zinc, and scrap zinc, from which zinc is recovered in the form of spelter, alloy, pigment, chemical, etc., and so used again, thus affecting the consumption of primary spelter. The total quantity of secondary zinc recovered in 1910, so far as there is record, was 68,723 tons. For details of the recovery of secondary zinc in 1910 and previous years see under the heading "Secondary zinc" in this chapter.

World's consumption of spelter, by countries, 1907–1910, in short tons.

[Stocks disregarded except in the United States.]

	1907	1908	1909	1910
Austria-Hungary	34,171	35,926	36,155	37,258
Belgium	60,627	74,936	71,209	86,531
France	76,729	85,956	73,744	61,949
Germany	192,792	198,580	207,343	196,209
Great Britain	164,653	159,627	171,468	195,989
Holland	4,189	4,188	4,409	4,409
Italy	7,496	9,257	9,039	8,929
Russia	19,209	19,948	20,283	27,447
Spain	5,180	5,512	4,960	4,740
Other countries	13,228	11,020	9,921	13,228
United States	226,969	214,167	270,730	245,884
Total	795,315	812,114	879,200	882,573

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World's consumption of spelter, exclusive of secondary zinc, 1898–1910, in short tons.

Year.	Stocks considered.	Stocks disregarded.			
	United States.	United States.	Foreign countries.	Total world's consumption.	United States percentage.
1898	108,199	106,185	422,070	528,255	20.10
1899	124,555	128,636	422,181	545,869	22.66
1900	99,200	102,414	420,858	523,272	19.57
1901	141,697	137,789	424,496	562,285	24.51
1902	183,682	154,136	465,391	619,529	24.88
1903	154,381	157,900	480,162	638,062	24.75
1904	180,911	176,894	520,506	697,400	25.36
1905	200,438	198,835	534,285	733,120	27.13
1906	220,781	221,142	556,882	778,024	28.42
1907	226,969	249,511	568,346	817,857	30.51
1908	214,167	207,423	597,947	805,370	25.75
1909	270,730	262,314	668,472	870,784	30.12
1910	245,884	257,940	636,689	894,809	28.83

Statistics of the use of spelter are not collected by the United States Geological Survey. The following table is from figures published in the Engineering and Mining Journal, which, though confessedly not complete, will, nevertheless, give an idea of the relative importance of the different uses of spelter for the period included.

Consumption of spelter in the United States, 1906–1910, by uses.

Use.	Percentage of total consumption.					
	1905	1906	1907	1908	1909	1910
Galvanizing	50.00	55.00	62.7	62.2	62.7	60.0
Brass making	26.00	25.25	18.4	17.2	18.3	20.0
Sheet zinc	17.00	16.00	12.4	14.1	12.6	11.0
Lead desilverization	1.25	1.00	1.1	1.3	1.0	1.0
Other purposes	5.75	2.75	5.4	5.2	5.4	8.0
Total	100.00	100.00	100.0	100.0	100.0	100.0

PRICES AND VALUE.

PRICES.

Spelter opened at St. Louis in January at 6.05 to 6.075 cents per pound, the highest price of the year, and declined rapidly until the first week in May, when the minimum for the year was reached at 4.85 cents per pound. During the latter part of the year the price made a considerable recovery, reaching 5.90 cents per pound in the middle of November, but afterwards a decline set in and the year closed with spelter at 5.3 cents per pound. The average St. Louis price of prime western spelter was 5.4 cents per pound, the same as for 1909. The average price of spelter at New York in 1910 was 5.5 cents, also the same as in 1909. These values are used by the United States Geological Survey in calculating the value of the domestic production of primary spelter for these years.

The London spelter market was very steady as compared with the American market. The year opened with spelter at £23 1s. 3d. (4.98 cents per pound) and remained nearly stationary through the

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first quarter, declining gradually until the middle of June, when the lowest price of the year was recorded at £21 15s. per long ton (4.7 cents per pound). From this on a gradual recovery brought the price up to the highest point of the year in November, closing the year at practically the same figure, £23 17s. 6d. per long ton (5 16 cents per pound). The average London price of spelter for 1910 was £23 1s. 1d. per long ton (4.98 cents per pound).

The price of zinc dust in 1910 varied between 6.5 and 7 cents per pound, the average for the year being 6.7 cents. In 1909 the price of zinc dust, duty free, in the first seven months, ranged from 5 to 5 5 cents per pound. After the new tariff became effective, August 6, 1909, the price varied from 6 to 6.5 cents per pound, the average for the year being 5.7 cents.

The following table, giving highest and lowest prices of spelter in each month for the years 1902–1910, inclusive, is based on figures in the Iron Age prior to 1906. For 1906 and later, the figures are based on the daily quotations in the Engineering and Mining Journal. Prior to 1909 the quotations are from New York City, but for 1909 and after, St. Louis prices are taken.

Monthly price range of prime western spelter, 1902–1910.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	4.30	4.25	4.25	4.00	4.35	4.20	4.45	4.40
1903	4.90	4.55	5.05	4.97	5.75	5.05	5.75	5.50
1904	5.10	4.90	5.10	4.95	5.20	5.05	5.27	5.20
1905	6.20	6.10	6.15	6.10	6.15	5.87	6.00	5.75
1906	6.70	6.00	6.15	6.05	6.35	6.10	6.15	6.05
1907	6.80	6.70	6.90	6.70	6.90	6.75	6 80	6.55
1908	4.60	4.25	4.85	4.55	4.80	4.60	4.70	4.60
1909	5.20	5.075	5.075	4.525	4.625	4.55	4.95	4.60
1910	6.075	5.65	5.70	5.25	5.625	5.45	5.475	4.90

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	4.65	4.40	4.85	4.80	5.35	5.05	5.50	5.35
1903	5.80	5.75	6.25	5.75	6.25	5.87	6.00	5.80
1904	5.22	4.95	4.95	4.75	4.90	4.87	5.07	4.90
1905	5.70	5.40	5.35	5.25	5.6C	5.25	5.80	5.60
1906	6.10	5.90	6.20	6.00	6.05	5.97	6.05	6.02
1907	6.60	6.35	6.45	6.35	6.35	5.85	5.90	5.50
1908	4.675	4.55	4.675	4.45	4.70	4.40	4.775	4.65
1909	5.125	4.875	5.325	5.10	5.325	5.175	5.675	5.325
1910	5.175	4.85	5.075	4.925	5.075	4.95	5.275	5.00

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	5.50	5.30	5.50	5.40	5.35	5.10	5.00	4.50
1903	6.10	6.00	6.12	6.00	6.00	5.25	5.25	4.65
1904	5.15	5.07	5.37	5.15	5.80	5.37	6.12	5.80
1905	5.95	5.75	6.15	6.00	6.26	6.10	6.60	6.40
1906	6.35	6.05	6.30	6.15	6.45	6.25	6.65	6.45
1907	5.50	5.05	5.55	5.25	5.25	4.50	4.55	4.10
1908	4.825	4.70	4.875	4.75	5.05	4.875	5.15	5.10
1909	5.80	5.55	6.275	5.775	6.275	6.175	6.225	6.00
1910	5.45	5.225	5.725	5.375	5.90	5.70	5.775	5.275

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VALUE.

The value of the 1910 production of domestic primary spelter, 252,479 tons, based upon the average St. Louis price, was $27,267,732, as compared with 230,255 tons, valued at $24,864,300, St. Louis price, in 1909, and with 190,749 tons, valued at the average New York price at $17,930,406, in 1907.

PRICE CURVES, 1907–1910.

The following curves show graphically for the years 1907–1910, inclusive, the relations of the weekly average St. Louis price of spelter, the weekly average London price of spelter, the weekly average price of 60 per cent zinc blende concentrates at Joplin, Mo., and the weekly production, or to be more exact, the weekly sales of concentrates in the Joplin region as a whole. The price of spelter has been taken from market reports, and the price of zinc blende and the figures of weekly production are those published in the Joplin Globe and the Joplin News-Herald. To eliminate the sharp weekly fluctuations and to obtain a curve more easily comparable with the price curves, the weekly sales have been averaged by months, the result being shown by the broken line.

The curve of London price of spelter shows the stabilizing effect of the Zinc Convention. The St. Louis price of spelter shows a minor dependence upon the English market, but a major independence of it. On the whole the price of zinc concentrates at Joplin shows a close correspondence to the price of spelter at St. Louis, though there are various minor discrepancies.

1907.

The London spelter market opened at the high level of the preceding year, £28 2s. 6d. per long ton (6.10 cents per pound), but broke sharply in January and February, declining more gradually until September, when a price of £20 15s. per long ton (4.49 cents per pound) was reached. At this point pig lead became worth more than spelter, and where the two metals had uses in common a large demand was transferred from lead and lead products to spelter and zinc products. This supported the spelter market for a time, but during the last month of the year, the price of spelter in the United States reached such a figure that it became profitable to export spelter to London, further depressing the market. A decline closed the year with spelter at £19 5s. per long ton (4.16 cents per pound), the extreme fluctuation for the year being £8 17s. 6d. per long ton (1.94 cents per pound).

The St. Louis market opened with spelter at the maximum figure for the preceding year and the price continued upward until in the middle of March. Then the business depression made itself felt and spelter dropped sharply until the middle of September, when there was a rally, reflecting the London market, after which a rapid decline brought spelter below 4 cents per pound in December. The average price all through December was considerably below the London price.

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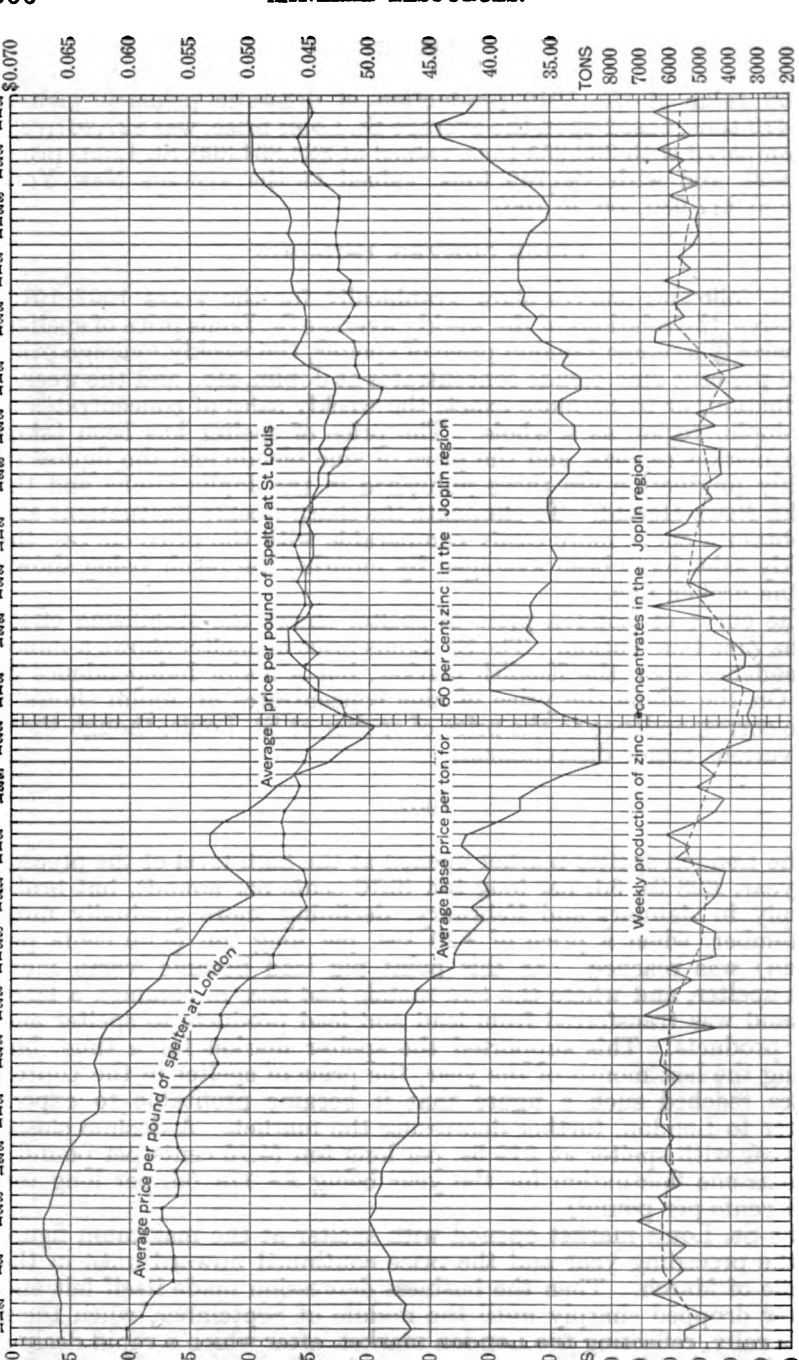

FIGURE 2.—Average weekly price of spelter at London and St. Louis, of 60 per cent zinc concentrates at Joplin, and weekly production (sales) of zinc concentrates in the Joplin region in 1907–1908.

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FIGURE 3.—Average weekly price of spelter at London and St. Louis, of 60 per cent zinc concentrates at Joplin, and weekly production (sales) of zinc concentrates in the Joplin region in 1909–1910.

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1908.

Rumors culminating in February in the report that the Zinc Convention was successfully accomplished carried spelter to £22 per long ton (4.76 cents per pound). Prices held up well for awhile, but, in the face of dull conditions and discouraging rumors with regard to the Zinc Convention, the market declined until in July the minimum price for the year, £18 per long ton (3.89 cents per pound), was reached. From this point the price rose by stages to £21 1s. 1d. per long ton (4.55 cents per pound) at the close of the year. The price at St. Louis during the first part of the year closely followed the London market, though reaching neither so high in February nor so low in July. Through most of February, March, and April the weekly average London price was higher than the equivalent St. Louis price. After July the St. Louis price took a parallel course to the London market at a figure about one-half cent above.

1909.

The long advance in spelter prices which marked the latter half of 1908 was continued into 1909. The announcement of the Zinc Convention came in the latter part of January and first resulted in overstimulation, followed by a slight recoil in March, after which a long steady ascent brought spelter up to £23 5s. per long ton (5.02 cents per pound), near which point it remained for the last quarter of the year. St. Louis spelter remained steady through January, but in a sharp break in February dropped one-half cent per pound, consequent apparently upon a preceding similar break in the price of zinc ore at Joplin, which had followed the decision of the United States Circuit Court of Appeals, January 18, 1909, admitting all classes of zinc ore imports free of duty. After a period of stagnation prices began to trend upward and, in response to the imminence of tariff legislation with a probable tariff on Mexican ore, rose higher and higher until 6¼ cents per pound was reached in October, a full cent and a quarter above the London price. A slight decline closed the year.

1910.

The London price of spelter remained fairly steady through the first quarter, but in April and May there was a considerable decline consequent upon increase in stocks and dissensions among the members of the Zinc Convention which made it seem probable that the agreement would not be renewed. The great drop in the price of spelter in the United States doubtless was also influential. However, conditions improved, the Convention was renewed, and spelter slowly rose to the end of the year. At St. Louis spelter held steady through January, but at this time the large stocks in the hands of consumers and dealers began to make themselves felt, stocks accumulated in the preceding year in the expectation of tariff increases and business revival, and in the next three months by a series of plunges, followed by partial recoveries, spelter reached 5 cents and went slightly below. A period of readjustment followed for three months with stationary price and curtailed production, after which spelter mounted rapidly until the close of November, but was then overtaken by a sharp reaction.

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THE JOPLIN ORE SCALE.

Upon the organization of the Zinc Ore Producers' Association at Joplin, early in 1910, that body undertook to ascertain the best methods of marketing Joplin ore. The central selling agency and the sliding-scale contract were among the plans suggested. The ore scale was finally adopted, and by the close of the year about half the tonnage of the district had been contracted for under the uniform terms of the scale. That part of the contract governing prices is as follows:

Spelter quotation governing to be the average of the American Metal Market and Daily Iron Trade Reports, direct St. Louis wire, for the week preceding the delivery of such concentrates.

For concentrates, except sludges, carrying 60 units zinc, the sum of $37 per ton (2,000 pounds dry weight), when spelter is quoted at $5 per hundredweight, East St. Louis delivery.

Unit variation, $1 per ton for each unit above or below 60 per cent.

Price variation, 8.5 cents per ton up or down for each change of 1 cent per 100 pounds spelter.

Premium of $1 per ton for concentrates carrying one-half of 1 per cent lead or less.

Iron allowance: Two per cent, no penalty; above 2 per cent to and including 5 per cent, $1 per ton per unit penalty; above 5 per cent, 50 cents per unit

THE ZINC CONVENTION.

The Zinc Convention was formed early in 1909, to remain in force until the close of 1910. It comprised the Zinkhüttenverband m. b. H. and the Société Anonyme des Mines et Fonderies de la Vieille Montagne. The former association embraces 18 zinc smelting firms in Silesia, the Rhine district, Belgium, and Austria. One large firm, Georg von Giesche's Heirs, did not join the association, but acted in concert. The Société Anonyme includes 10 smelters, the majority located in Belgium. The more important English smelters joined the convention late in 1909. The purpose of the Convention was to fix beforehand, within certain limits, the production of smelter by its members, and, if the market gave evidence that the consumption was not keeping pace with the production, further to curtail production. The output of the German group was limited to 255,700 metric tons in 1909 and to 264,200 metric tons in 1910, and the output of the Franco-Belgian group was not to exceed 174,500 metric tons in 1909 and 176,900 metric tons in 1910. The output of the English smelters under the terms of the agreement was to be approximately 55,000 metric tons annually. If the average price of ordinary brands of spelter remained below £19 per long ton (4.11 cents per pound) for six consecutive months, a pro rata reduction of the fixed output was to be made.

At the close of 1910 the Zinc Convention had, on the whole, worked so well that it was extended until April 30, 1914. Certain features which had aroused antagonism (notably the restriction clause) were modified in the new terms. Under the new agreement there will be no restriction of output so long as the total stocks of spelter, ascertained every quarter, do not exceed 50,000 metric tons and so long as the London price of spelter does not fall below £22 per long ton (4.8 cents per pound). Should this contingency arise, production is to be restricted pro rata on the basis of each smelter's output during the last quarter. The outstanding smelting firm, Georg von Giesche's

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Heirs, will sell its output through the association agencies and has agreed to the limitation clause, though it does not regularly become a member.

The steadying effect of the convention upon the European spelter market since its organization in 1909 is very graphically shown in the spelter price curves given on preceding pages.

SUMMARY.

Summary of spelter statistics for 1907–1910.

	1907	1908	1909	1910
Production of spelter by United States	249,960	210,424	255,760	269,184
Consumption of spelter bJ United States (stocks considered)	226,909	214,167	270,780	245,884
Production of zinc by world	813,842	796,832	854,056	883,419
Consumption of zinc by world (stocks considered in United States)	795,315	812,114	879,200	882,573
Excess of world production over consumption	18,527	.....	.....	846
Excess of world consumption over production	.....	15,060	18,740	.....
United States percentage of world production	30.7	26.4	29.9	30.5
United States percentage of world consumption (stocks considered in United States)	28.5	26.4	30.8	27.9
Rank of United States among spelter-producing countries	First.	Second.	First.	First.
Rank of United States among spelter-consuming countries	First.	First.	First.	First.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE WESTERN STATES.

(MINE PRODUCTION.)

INTRODUCTION.

By H. D. McCaskey.

The following table shows at a glance the mine production of gold, silver, copper, lead, and zinc metals and ores in the Western States and Territories, including Alaska, in 1910:

Mine production of gold, silver, copper, lead, and zinc in the Western States and Territories in 1910.

State or Territory.	Ore sold or treated.	Gold.		Silver.		Copper.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*		*Pounds.*	
Alaska	1,526,625	780,131.48	$16,126,749	157,850	$85,239	4,241,689	$538,695
Arizona	3,914,969	152,350.58	3,149,366	2,566,528	1,385,925	297,491,151	37,781,376
California	2,697,885	953,734.41	19,715,440	1,840,085	993,646	48,700,756	6,184,996
Colorado	2,521,927	992,028.93	20,507,058	8,509,598	4,595,183	8,359,535	1,061,661
Idaho	1,786,174	53,059.73	1,096,842	7,369,742	3,979,661	7,037,292	893,736
Montana	5,079,446	180,462.26	3,730,486	12,162,857	6,567,942	284,808,553	36,170,686
Nevada	3,655,775	913,265.05	18,878,864	12,479,871	6,739,130	64,359,398	8,173,643
New Mexico	191,805	23,337.26	482,424	843,987	455,753	4,614,386	586,027
Oregon	82,132	32,870.23	679,488	35,978	19,428	13,861	1,760
South Dakota	1,523,929	261,334.18	5,402,257	118,800	64,152	.....	.....
Texas	21,917	20.46	423	380,322	205,374	3,157	401
Utah	6,380,398	195,052.11	4,032,085	10,466,971	5,652,164	127,597,072	16,204,828
Washington	59,209	38,126.51	788,145	205,345	110,886	86,918	11,038
Wyoming	1,474	154.75	3,199	1,478	798	222,339	28,237
Total	29,452,725	4,575,927.94	94,592,826	57,139,412	30,855,281	847,536,107	107,637,084

State or Territory.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Alaska	.....	.....	.....	.....	$16,750,683
Arizona	2,696,998	$118,668	5,484,899	$296,184	42,731,519
California	2,870,977	126,323	.....	.....	27,020,405
Colorado	76,071,273	3,347,136	77,089,648	4,162,841	33,673,879
Idaho	228,258,839	10,043,339	5,603,114	302,568	16,316,196
Montana	4,106,292	180,677	31,638,184	1,708,462	48,358,253
Nevada	4,871,130	214,329	2,707,071	146,182	34,152,148
New Mexico	4,320,841	190,117	18,088,129	976,759	2,991,080
Oregon	.....	.....	.....	.....	700,676
South Dakota	14,136	622	.....	.....	5,467,031
Texas	65,068	2,863	.....	.....	209,061
Utah	123,324,635	5,426,284	16,367,104	883,824	32,199,185
Washington	1,322,287	58,180	.....	.....	968,249
Wyoming	.....	.....	.....	.....	32,234
Total	447,922,476	19,708,588	156,978,149	8,476,820	261,270,599

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The area covered by these figures and the following chapters in which the output of the States and Territories is treated in detail lies west of the one hundred and third meridian, which passes through western South Dakota and eastern Colorado, between New Mexico and northern Texas, and through trans-Pecos or western Texas. It includes all mines and mining districts of the United States except those of the Central and Eastern States, the corresponding mine output of which is covered by separate reports of the United States Geological Survey.

This area embraces physiographic and geologic regions and ore deposits of various metallogenetic provinces, and of classification according to the genesis or according to form, that need not be reviewed in detail here. An outline map on the scale of 40 miles to the inch and showing the location and principal metals of the mining districts of this area was published in the Western States mine report of the Survey for 1907, and copies of this map can still be had at cost from the Director of the Survey. A forthcoming bulletin of the Survey, by James M. Hill, will contain revised maps on the same scale, also showing locations of mining districts by States, and will give condensed notes on districts, and contain an introduction by Waldemar Lindgren [illegible] the geology of the area covered by that bulletin and this [illegible].

Of the total mine output of gold in the United States in 1910, valued at $94,778,348, the Western States supplied $94,592,826; of the total production of silver of 57,195,750 fine ounces, the Western States supplied 57,139,412 ounces. The preponderance of the precious metal output by these States is obvious. Of the total mine production of 1,088,237,432 pounds of copper in the United States in 1910, the Western States are credited with 847,536,107 pounds, the remainder being produced chiefly in Michigan, but also in considerable part in Tennessee. Of the total lead output of mines in the United States of 790,573,326 pounds in 1910, the Western States produced 447,922,476 pounds, the remainder coming chiefly from Missouri. Finally, of the total zinc production (figured as spelter) of 653,434,034 pounds, the Western States supplied 261,270,599 pounds; the Central States, mainly Missouri, 357,568,000 pounds; and the Eastern States, mainly New Jersey, 140,875,886 pounds. The total value of the mine output of these metals for 1910 was $10,127,304 in the Eastern States, $62,866,732 in the Central States, and $261,270,599 in the Western States, or $334,264,635 for the mine production of gold, silver, copper, lead, and zinc of the United States.

The data for this report are confidential returns to the Survey from the producers, and these are checked and verified by other data, both confidential and published. These data are reported to, and verified, interpreted, and compiled by, A. H. Brooks, in charge of the division of Alaskan Mineral Resources, for Alaska; Chas. W. Henderson, in charge of the Denver office of the division of Mineral Resources of the Survey, for Colorado, New Mexico, South Dakota, Texas, and Wyoming; V. C. Heikes, in charge of the Salt Lake City office, for Arizona, Idaho, Montana, Nevada, Utah, and Washington; and Chas. G. Yale, in charge of the San Francisco office, for California and Oregon. For final checking of all figures by J. P. Dunlop and editing of all chapters by W. T. Thom, cordial acknowledgment is made. Cooperation with the Survey of the mining and metallurgical

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industries, of merchants, bankers, and transportation officials, of the the Bureau of the Mint, of the Post Office Department, of the Bureau of Statistics of the Department of Commerce and Labor, and of other officials, public and private, is also gratefully acknowledged.

The Survey prices for values of the metals for 1910 as used in this report are as follows:

Gold	per fine ounce..	$20.671834625323
Silver	do....	.54
Copper	per pound..	.127
Lead	do....	.044
Zinc (spelter)	do....	.054

The classification of ores adopted is necessarily arbitrary in part. An ore is generally understood to be worked at a profit for one or more metals. The complex nature of western ores especially and the insensible gradations from one to another render essential some fixed measures for the terminology used. The dry or siliceous ores comprise gold and silver ores proper. These can not conveniently be subdivided between gold ores and silver ores, for both metals occur together in all proportions, and the tables are of primary classification rather than of great detail. The quantity of purely silver ores and the number of mines producing them are also relatively small. The copper ores include those containing over 2½ per cent of copper, or below this, in the case of ores of the great disseminated copper deposits. The lead ores are those containing 4½ per cent or more of lead, and the zinc ores those containing 25 per cent or more of zinc, both irrespective of their precious-metal content.

ALASKA.

By Alfred H. Brooks.[1]

INTRODUCTION.

Gold placer mining in 1910 showed marked decrease in amount of actual gold production, though considerable advance was made in preparation for more extensive operations. The output from gold lodes was a little less than in 1909, but a large amount of dead work was accomplished, which even by 1911 will result in a considerably increased production. The copper output increased in 1910 and much prospecting and dead work were accomplished in the copper mines, which will assure a growing production.

As in previous years, the lack of cheap fuel is the greatest hindrance to the advancement of the mining industry in Alaska. So long as the Pacific seaboard of Alaska and the adjacent portions of the inland region have to depend on coal brought from British Columbia, Japan, and Washington, the industries of the Territory must suffer. With coal at $8 to $20 a ton along the seaboard of Alaska, even mines located at tidewater are at great economic disadvantage, and only the richest or largest ore bodies can be mined at a profit. Moreover, railway construction will only be active when there is an assured tonnage from the coal field and when cheap fuel for operating is

[1] Aid has been rendered in the preparation of this report by E. M. Aten, who assisted in the collection of statistics from mines. The data on mining development here presented are all taken from Bulletin 480, which deals with the region in a more detailed way. See Brooks, Alfred H., and others, Mineral Resources of Alaska, 1910, Bull. U. S. Geol. Survey No. 480, 1911.

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available. These conditions are in part being rectified by the increasing use of California fuel oil.

The inadequacy of the mineral land laws which apply to placer claims continues to hamper the mining industry by discouraging the bona fide miner and prospector. This condition is emphasized where a new district is discovered, and a few men, often mere speculators and not miners, can preempt large tracts of land and hold them for a year or more without development work.

In spite of the decreased gold production and the handicap because of the delay in opening the coal fields, copper mining was active, as stated above, and more has been accomplished than in any previous year in the development of auriferous lodes. Much work was also done toward erection of large mining plants for working low-grade placer deposits.

The decrease in the value of the gold production is chargeable to the falling off in the output from the placer mines of Fairbanks, Seward Peninsula, and some of the smaller placer districts. Except in these camps, the output from all the mining districts increased. Fairbanks still leads in gold production, with the Seward Peninsula second. The Juneau district, which is third in the value of its gold production, is still by far the most important of the auriferous lode districts, but lode mines were also operated near Valdez and in the Willow Creek and Fairbanks districts. Many promising prospects were found in other regions also, notably on the Kenai Peninsula.

Ketchikan still leads in copper production, but there was an output from Prince William Sound. The continuation of constructive work on the Copper River Railway [1] stimulated prospecting in the Chitina district.

As in previous years, attempt has been made to base statistics of production, so far as possible, on statements of individual producers—the only reliable source of information. Though the cordial cooperation of most of the important mine operators has been secured, there are still a few large producers and many smaller ones who neglect to reply to the request for information. In the meantime recourse is had to other sources of information. In connection with this work the writer is under special obligations to the Director of the United States Mint, to the many United States commissioners in the Territory, to bank officials, to the agents of the customs service, and to prominent residents for valuable information. All these data have been carefully sifted, and the accompanying figures are based upon them. The limit of error of the statement of the total gold production of the Territory is believed to be within 2 per cent. In the crediting of the proper amounts to individual districts, however, the error may in some cases be as high as 8 per cent. A preliminary estimate of the distribution of the gold output has already been published.[2]

The following table is an estimate of the total gold, silver, and copper production of Alaska since the beginning of auriferous mining in 1880. For the early years the figures are probably very far from being correct, but they are based on the best information now available.

[1] Completed to Bonanza mine in April, 1911. [2] Bull. U. S. Geol. Survey No. 480, 1911, pp. 25–26.

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Production of gold, silver, and copper in Alaska, 1880–1910.

Years.	Gold.		Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.	Quantity (pounds).	Value.
1880	967	$20,000			3,933	$826
1881	1,935	40,000				
1882	7,256	150,000				
1883	14,561	301,000	10,320	$11,146		
1884	9,723	201,000				
1885	14,512	300,000				
1886	21,575	446,000				
1887	32,658	675,000				
1888	41,119	850,000	2,320	2,181		
1889	43,538	900,000	8,000	7,490		
1890	36,862	762,000	7,800	6,071		
1891	43,538	900,000	8,000	7,920		
1892	52,245	1,080,000	8,000	7,000		
1893	50,213	1,038,000	8,400	6,570		
1894	62,017	1,282,000	22,261	14,257		
1895	112,642	2,328,500	67,200	44,222		
1896	138,401	2,861,000	145,300	99,087		
1897	118,011	2,439,500	116,400	70,741		
1898	121,760	2,517,000	92,400	54,575		
1899	270,997	5,602,000	140,100	84,276		
1900	395,030	8,166,000	73,300	45,494	250,000	40,000
1901	335,369	6,932,700	47,900	28,598		
1902	400,709	8,283,400	92,000	48,590	360,000	41,400
1903	420,069	8,683,600	143,600	77,343	1,200,000	156,000
1904	443,115	9,100,000	198,700	114,934	2,043,586	275,676
1905	756,101	15,630,000	132,174	80,165	4,805,236	749,617
1906	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907	936,044	19,349,743	149,784	98,857	6,308,786	1,261,757
1908	933,290	19,292,818	135,672	71,906	4,585,362	605,267
1909	987,417	20,411,716	147,950	76,934	4,124,705	536,211
1910	780,131	16,126,749	157,850	85,239	4,241,689	538,695
Total	8,647,830	178,766,520	2,118,631	1,280,441	33,795,108	5,338,709

PRODUCTION.

The production and value of gold, silver, and copper for 1909 and 1910 are shown in the following table:

Mine production of gold, silver, and copper in Alaska, 1909–10.

	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	987,416.76	$20,411,716	780,131.48	$16,126,749	−207,285.28	−$4,284,967
Silver.....do....	147,950	76,934	157,850	85,239	+ 9,900	+ 8,305
Copper.....pounds..	4,124,705	536,211	4,241,689	538,695	+116,984	+ 2,484

The value of gold production of Alaska in 1910 is estimated at $16,126,749 and that of silver at $85,239, and the number of ounces of gold at 780,131.48 and of silver at 157,850. In 1909 the output of gold was valued at $20,411,716. The copper output of Alaska for 1910 was 4,241,689 pounds, valued at $538,695, an increase from 1909 of 116,984 pounds. Much dead work was also accomplished, assuring a large increase in copper production in 1911.

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Comparison is made in the following table between the gold production of 1909 and of 1910 by districts:

Value of gold production in Alaska in 1909 and 1910, by districts.

Districts.	1909	1910	Increase (+) or decrease (−).
Pacific coast belt, including southeastern Alaska and Prince William Sound	$4,264,716	$4,182,730	− $81,986
Copper River and Cook Inlet region	265,000	351,630	+ 86,630
Yukon and Kuskokwim basins	11,580,000	8,062,389	−3,517,611
Seward Peninsula and northwestern Alaska	4,302,000	3,530,000	− 772,000
Total	20,411,716	16,126,749	−4,284,967

The following table shows the production of gold, silver, and copper in 1910, by districts:

Mine production of gold, silver, and copper in Alaska in 1910, by districts.

Districts.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Pacific coast belt, including southeastern Alaska and Prince William Sound	*Fine ounces.* 202,339.56	$4,182,730	*Fine ounces.* 47,212	$25,495	*Pounds.* 4,241,689	$538,695
Copper River and Cook Inlet	17,010.10	351,630	2,826	1,526	.....	.....
Yukon and Kuskokwim Basins	390,018.07	8,062,389	87,176	47,075	.....	.....
Seward Peninsula and northwestern Alaska	170,763.75	3,530,000	20,636	11,143	.....	.....
Total	780,131.48	16,126,749	157,850	85,239	4,241,689	538,695

Value of gold production of Alaska, with approximate distribution, 1880–1910.

Years.	Pacific coast belt.	Copper River and Cook Inlet region.	Yukon Basin.	Seward Peninsula and northwest Alaska.	Total.
1880	$20,000	.....	.....	.....	$20,000
1881	40,000	.....	.....	.....	40,000
1882	150,000	.....	.....	.....	150,000
1883	300,000	.....	$1,000	.....	301,000
1884	200,000	.....	1,000	.....	201,000
1885	275,000	.....	25,000	.....	300,000
1886	416,000	.....	30,000	.....	446,000
1887	645,000	.....	30,000	.....	675,000
1888	815,000	.....	35,000	.....	850,000
1889	860,000	.....	40,000	.....	900,000
1890	712,000	.....	50,000	.....	762,000
1891	800,000	.....	100,000	.....	900,000
1892	970,000	.....	110,000	.....	1,080,000
1893	838,000	.....	200,000	.....	1,038,000
1894	882,000	.....	400,000	.....	1,282,000
1895	1,569,500	$50,000	709,000	.....	2,328,500
1896	1,941,000	120,000	800,000	.....	2,861,000
1897	1,799,500	175,000	450,000	$15,000	2,439,500
1898	1,892,000	150,000	400,000	75,000	2,517,000
1899	2,152,000	150,000	500,000	2,800,000	5,602,000
1900	2,606,000	160,000	650,000	4,750,000	8,166,000
1901	2,072,000	180,000	550,000	4,130,700	6,932,700
1902	2,546,000	375,000	800,000	4,561,800	8,283,400
1903	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904	3,195,400	500,000	1,300,000	4,164,600	9,160,000
1905	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906	3,454,794	332,000	10,750,000	7,500,000	22,036,794
1907	2,891,743	275,000	9,183,000	7,000,000	19,349,743
1908	3,448,318	401,500	10,323,000	5,120,000	19,292,818
1909	4,264,716	265,000	[a]11,580,000	4,302,000	20,411,716
1910	4,182,730	351,630	[a] 8,062,389	3,530,000	16,126,749
Total	52,212,301	4,360,130	64,979,389	57,214,700	178,766,520

[a] Includes a small production from the Kuskokwim.

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About three-fourths of the gold in 1910 was from the placer mines. This ratio will, however, not continue, for the gold production from the auriferous lodes, if a period of years be considered, is increasing, while that from the placers is decreasing. The gold output of the siliceous ores is second in value and that of the copper ores third. The value of the gold production from the auriferous lode mines was $4,117,440 in 1909 and $4,105,459 in 1910—a decrease of $11,981.

In the following table the source of the precious metals is indicated:

Sources of gold, silver, and copper in Alaska, 1910, by kinds of ore.

	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Siliceous ores	198,601.58	$4,105,459	30,123	$16,266		
Copper ores	1,764.91	36,484	26,388	14,250	4,241,689	$538,695
Placers	579,765.00	11,984,806	101,339	54,723		
Total	780,131.49	16,126,749	157,850	85,239	4,241,689	538,695

Twelve auriferous lode mines were productive in 1910, the same number as in 1909. Operators of 7 copper mines made shipments of ore in 1910, as in 1909.

The tonnage of all the lode mines in 1910 was 1,526,625 short tons, as against 1,531,030 short tons in 1909. There was a decrease of 9,101 short tons in the quantity of siliceous ores mined and an increase of 4,696 short tons in the quantity of copper ore mined. Of siliceous ores, 1,487,260 short tons were mined, of which 1,375,612 tons were from the three mines of the Treadwell group. The average gold and silver extraction from all siliceous ores was valued at $2.77. For the 111,648 short tons of siliceous ores other than those of the Treadwell group the gold and silver recovery was a little more than 10 per cent of the total value of the siliceous ore in Alaska. The total tonnage of copper ore was 39,365 short tons, which yielded an average value of $1.27 in gold and silver and 5.38 per cent of copper.

It is estimated that there were about 650 placer mines operated in Alaska in 1910, and that the total quantity of auriferous gravel excavated was 3,800,000 cubic yards, with an average recovery in gold of $3.20 per yard. In 1909 it is estimated that 4,020,000 cubic yards of gravel were mined, with an average gold recovery of $4 per cubic yard. Eighteen gold dredges were operated for at least part of the season in 1910, and the gold recovered by this method of mining is estimated to have a value of about $800,000. In 1909 eight dredges were operated, and their total gold output is estimated to have been $425,000.

REVIEW BY DISTRICTS.

PACIFIC COASTAL BELT.

SOUTHEASTERN ALASKA.

The auriferous lode mines of southeastern Alaska in 1910 produced gold to the value of $3,839,626, as compared with an output of $4,098,900 in 1909. The copper mines of this region produced 2,254,487 pounds of copper in 1910 and 2,705,988 pounds in 1909.

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Juneau district.—Seven mines were productive in the Juneau district in 1910. These are the three mines of the Treadwell group, the Perseverance and the Alaska-Juneau in the Silverbow Basin, near Juneau, and the Eagle River, north, and the Crystal mine, south of Juneau. Much work was done in the Berners Bay region. Though no mine was on a productive basis, it seems probable that both the Kensington and the Jualin will make an output in 1911. There was also a large amount of dead work accomplished in the region lying between Juneau and Berners Bay.

The steadily increasing depth from which ore is extracted at the Treadwell group of mines has made advisable an enlargement of the hoisting capacity, and it has been decided to make the shaft of the Seven Hundred Foot claim the main hoisting shaft of the three mines that are grouped on the same lode—the Alaska-Treadwell, the Seven Hundred Foot, and the Alaska-Mexican. A contract has been let for a balanced hoist capable of lifting 5,000 tons from a depth of 3,000 feet in 20 hours, the net load being 8 tons. A new gallows frame and new crushing machinery of heavier capacity will be erected.

The hydraulic electric plant at the mouth of Sheep Creek, which is capable of generating 2,500 horsepower for about two-thirds of the year, and the transmission line to Treadwell were completed during the year. Work was started on a transmission line from Treadwell to Nugget Creek at Mendenhall Glacier, a distance of 12 miles, where it is proposed to build a dam, probably 125 feet high, which will have a storage capacity equivalent to approximately 5,000 horsepower for 90 days.

Pelton wheels have been erected at the Ready Bullion and the Mexican mills, and the stamps are now operated by water power developed from the Ready Bullion dam.

A cyanide plant, capable of handling 100 tons of concentrates a day, has been completed and will render shipment of the sulphurets to the smelter unnecessary in the future.

At the Alaska Treasure mine, on Nevada Creek, 3,100 feet of the projected 3,500-foot double-track tunnel has been completed. Mining was resumed at the Perseverance mine on May 25. A force of 110 men was employed and the 100-stamp mill was in operation during the season. Work at the Alaska-Juneau mine began on June 4, employing 30 men. Most of the ore extracted during the year came from the upper pit. On the Ebner property the California & Nevada Copper Co. commenced work on a new 200-stamp mill.

The various mines and prospects at Berners Bay were idle during 1910, but active development on a scale commensurate with their magnitude and importance was in prospect for 1911.

There was little activity in the region lying between Berners Bay and Eagle River to the south. At Amalga the Eagle River mine operated 10 stamps intermittently during the year, and exploration work was continued.

At the Mitchell & McPherson prospect, which is situated on the northwest flank of Thane Mountain between Eagle and Herbert glaciers, a new tunnel projected to undercut the ore body 100 feet vertically below the lowest outcrop was begun.

Considerable development and exploration work was done on the Peterson group of claims on Peterson Creek. A 4-mile planked

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horse tramway was built from Pearl Harbor to the camp on the Prairie claim, and a 500-foot crosscut tunnel was started.

On the Dull & Stephens prospect near Auk Bay a large body of low-grade quartz has been exposed by stripping the overburden by booming.

Extensive croppings of quartz have been uncovered near Treasury Hill a few miles from Auk Bay, but no important development work was undertaken during 1910. There was little activity in the gold belt south of Juneau. At the Crystal mine at Port Snettisham operations were suspended in September. At Limestone Inlet the drifting and stripping has been done on a prospect known as the Enterprise, which is situated at an altitude of 1,370 feet.

Porcupine district.—There was a little placer mining during 1910 on Gold Creek, near Juneau, but the only important mining ventures in this part of Alaska are those of the Porcupine district, lying about 40 miles from tidewater, on Lynn Canal. The largest operator in this field was the Porcupine Gold Mining Co., which operated its hydraulic plant for a good part of the season in 1910. A high line flume was completed and a bedrock drain extended 2,000 feet.

The Cahoon Creek Placer Mining Co., in the same district, accomplished much dead work, including the building of flumes. Its plant was completed in time to do considerable hydraulicking. In addition there were some smaller operations in the district.

Sitka and Ketchikan districts.—The only active gold mines in the Sitka district were the Chichagof (locally known as De Groff) and the Golden Gate mines. They are situated at the head of Klag Bay, on the west coast of Chichagof Island, 50 miles north of Sitka. Both mines are operating on what is presumably the same lode and were producing in 1910 a comparatively high-grade ore. The ore milled during the year at the De Groff mine came from the rich ore shoot developed by the raise from the adit level to the upper tunnel.

On the Golden Gate property the stamp mill and aerial tram were completed and the milling of the ore commenced. The mill has been built for 10 stamps, but only 5 have been set up. The ore milled was mainly from the dump accumulated during the early development of the mine, but underground development was continued.

No gold mines were on a productive basis in the Ketchikan district in 1910. Several hundred feet were driven on the proposed 1,600-foot crosscut at the Lon-de-Van group, which is situated on the north shore of George Inlet. Development continued on the Julia claim at Hollis until September, when the mine was shut down. Late in the year a small force of men was put to work on the Goldstream property on Gravina Island, 3 miles from Ketchikan, with a view to reopening the property.

During 1910 copper ore was shipped from 4 mines in the Ketchikan mining district, 3 of which are situated on Kasaan Peninsula, and 1 on Hetta Inlet. The main supply of ore at Mount Andrew mine in 1910 was obtained from stopes 2 and 4. Considerable drifting was done on the 50-foot level, and good ore was encountered. A raise was put through from this level to ore shoot No. 4, from which a large tonnage of rich ore has been extracted in the past and which is now being stoped downward from the main adit level, tunnel No. 1. A new tunnel, known as No. 2, was started several hundred feet north-

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west of No. 1, undercutting the outcrops at a depth of 100 feet, and enough ore was encountered to continue prospecting. The most noteworthy development work commenced during the year was that done on the new 1,600-foot tunnel, designated No. 3, which is projected to undercut the ore body 300 feet below the present working level.

At the It mine operations commenced for the year early in April. Development was on three levels below the working tunnel, the lowest being at a depth of 150 feet. From these levels the surrounding territory was carefully prospected by diamond drilling.

At the Dean, a newly discovered prospect not far from the It mine, a short tunnel was driven and a shallow winze was sunk.

Operations were resumed late in March at the Goodro mine after the winter shutdown. The main development undertaken consists of a winze sunk a depth of 100 feet below the tunnel. From the bottom of the winze short drifts were driven both east and west.

Hetta Inlet.—The only property on Hetta Inlet productive during 1910 was the Jumbo mine of the Alaska Industrial Co. In the stope on tunnel No. 4 (the working tunnel and deepest level) a vertical diamond-drill hole was put down 130 feet and ore was encountered, proving that at this property the contact-metamorphic ore has a vertical range of at least 700 feet. On the level of tunnel No. 1 the ore-bearing zone is being explored southeastward by diamond drilling. A tunnel, projected to be 5,000 feet long and to undercut the ore bodies at a depth of 1,500 feet, has been started from tidewater.

At the Red Wing mine it was reported that a crew of 12 men was employed in sinking a new 500-foot shaft.

At Big Harbor, near Klawak, on the west coast of Prince of Wales Island, the Northland Development Co. is said to be prospecting an ore body 62 feet wide and has driven an aggregate of 400 feet of drifts and tunnels.

At Seal Bay, on Gravina Island, the main crosscut tunnel has now attained a length of 1,700 feet, but driving ahead has been suspended. Late in the year a crew of six men was employed at the Rush & Brown mine, which is near the head of Karta Bay, on Prince of Wales Island. The mine was unwatered and preparations were made to get out a shipment of ore.

It is reported that work was resumed by a small force of men on the Moonshine vein on the South Arm of Cholmondeley Sound. The ores in this property are silver and lead, and it is one of the few of its class in southeastern Alaska.

Beach mining.—Beach mining was continued at a number of localities scattered along the Pacific seaboard from Lituya Bay to Unga Island. A large part of the gold recovered in this way comes from the Yakataga beach placers. The relatively small bulk of auriferous gravels contained in the beaches has usually discouraged anyone but individual operators, who, for the most part, use the rocker.

PRINCE WILLIAM SOUND.

The most important event of the year in the Prince William Sound region was the development of an auriferous lode mining district on Port Valdez. The most important prospects thus far discovered lie in an area bounded on the east by Valdez Glacier, on the south by

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Port Valdez, on the west by Shoup Bay and Shoup Glacier, and on the north by a less well-defined line lying from 2 to 5 miles from tidewater. Some prospects have also been located on the south side of Port Valdez. Within this area upward of 200 lode claims have been staked, most of them during 1910.

The Cliff mine, the only property which has been put on a productive basis, is located about 8 miles west of the town of Valdez. In April, 1910, a 3-stamp mill was built. The mine was operated until December, when it was temporarily closed down.

There is no exact information available regarding the many other properties which have been more or less prospected. Along the shores of Port Valdez, near the Cliff mine, are a number of veins, some of which have been developed by adit tunnels. At the Imperial an adit has been driven along the vein for about 100 feet and an air compressor has been installed. A 3-stamp mill has also been erected near here.

There was considerable gold lode prospecting in other parts of Prince William Sound in 1910. Encouraging results are reported from Jackpot Bay and McClure Bay, both on the western side of Prince William Sound.

In the aggregate important work was done on the copper lodes of Prince William Sound, though the low price of copper rather discouraged any except the strong companies from putting their properties on a shipping basis. Work was continued on properties on Landlocked and Galena bays, though so far as known neither made any shipments. The Glacial Copper Co. is said to have driven a tunnel 170 feet long and to have built a small bunker.

At the Beatson-Bonanza mine, on Latouche Island, ore bunkers of a capacity of 1,500 tons and a small water-power plant were built. A diamond drill is being used for prospecting. Ore shipments continued throughout the year. A compressor plant with air drills has been put up on the property of the Seattle-Alaska Copper Co. near Big Bay. At Ellamar a horseshoe-shaped cofferdam 400 feet in length and 20 feet above low tide was being completed. A steam pumping plant has been built and shipments of ore were made during the year.

KENAI PENINSULA.

Lode mining.—There was great activity in quartz prospecting on the Kenai Peninsula in 1910. The following notes are gleaned from various sources. Of the many properties which were developed to some extent, those of Watson & Snow, now incorporated under the name Wanowski Gold Mining Co., near Moose Pass, showed the greatest results. On this property several hundred feet of underground work has been accomplished.

On False Creek the California-Alaska Mining Co. continued work on a gold-bearing quartz prospect, on which an air compressor has been erected. Work was also continued on the Stevenson property, in the same neighborhood. Auriferous quartz veins have been staked at various other places in the Sunrise placer district, but these have been for the most part but little developed except for the annual assessment work. What appears to be a promising auriferous quartz vein was found north of Turnagain Arm, at the head of Crow Creek.

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Placer mining.—During 1910 there were a half dozen hydraulic plants, large and small, in operation in the Sunrise district. One of the largest of these is on Crow Creek, where the operations during 1910 consisted largely in removing, by hydraulic methods, the heavy overburden which covers the gold-bearing gravels. In addition to the hydraulic mines, 15 or 20 small operators made a gold output.

SOUTHWESTERN ALASKA.

There were but few mining developments in southwestern Alaska in 1910. Prospecting continued on the copper deposits of the Iliamna region, and steps were taken to open up an auriferous lode on Popof Island. Fifteen men were employed at the Apollo mine, chiefly in development work, but some ore was taken out. Prospecting of auriferous lodes was also done on Kodiak, Dry, and Afognak Islands.

COPPER RIVER REGION.

Kotsina-Chitina district.—The most important event of the year in the Kotsina-Chitina copper district was the extension of the Copper River & Cordova Railway to about mile 150. In April, 1911, the first trainload of copper ore was shipped to the coast from the Kennicott-Bonanza mine. This mine is now fully equipped to ship ore, of which a large quantity of extraordinary richness has been blocked out. The deepest workings are from 150 to 160 feet below the surface. During 1910 the most important development was the construction of ore bins and a concentrator at the railway terminal, which is connected with the mine by an aerial tram 15,000 feet in length.

The assurance of a railway has led to much prospecting of other claims in the Kotsina-Chitina district, detailed information in regard to which, however, is lacking. It is reported that the development work done on the Mother Lode group of claims, which lies on the McCarty Creek side of the Bonanza divide, has opened promising ore bodies. The work accomplished in the Kotsina region, at the western end of the copper belt, is also reported to have developed good ore bodies.

Bremner River region.—The Bremner and Tiekel River regions of the lower Copper River basin have long been known to carry auriferous gravels, some of which have been mined in a small way. In 1910 some auriferous quartz veins were found in this district.

Nizina district.—Two hydraulic plants were operated in the Nizina district, beside a number of smaller plants. The output, which can not be disclosed because this might indicate the production of individual operators, was nearly twice as large as that of 1909.

Chistochina and Valdez Creek districts.—Between 40 and 50 men were engaged in placer mining in Chistochina district in 1910, mostly on Slate Creek. Some productive work was also done on Miller Gulch and on Ruby and Lime creeks. Preliminary steps were also taken to erect a large mining plant in this district. Mining continued on Valdez Creek and its tributaries.

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SUSITNA BASIN.

The Yentna district in 1910 had the most profitable season in its history. The Cache Creek Mining Co. completed the installment of a hydraulic plant and did considerable mining. Another company carried on large operations on Nugget Creek. The success of these larger plants has encouraged the investigation of other properties with a view to introducing improved methods. It is estimated that about 200 men were engaged in mining and prospecting in the entire district.

Willow Creek district.—Work in the Willow Creek district in 1910 consisted of small placer mine operations, the productive operation of the Gold Bullion quartz mine, and the active prospecting of a large number of auriferous lode claims.

MULCHATNA REGION.

Mulchatna River heads in an unsurveyed area northwest of Lake Clark and flows into Bristol Bay. Placer gold has long been known in its drainage basin, and in 1910 some promising prospects are reported to have been discovered. A steamboat was built during the year at Bristol Bay for use on Mulchatna River. There are said to have been between 25 and 50 prospectors in this district in 1910.

YUKON BASIN.

The value of the placer production of the Yukon Basin, including the Innoko-Iditarod region, in 1910 is estimated at $8,020,000, as compared with $11,580,000 in 1909. This falling off is largely due to the decreased production of the Fairbanks district, the value of whose output was $6,100,000 in 1910 against $9,650,000 in 1909.

Fairbanks district.—It is estimated that about 130 placer mines were operated in the Fairbanks district during 1910, a decrease in number of over 50 per cent from the average of previous years. As the gold production has declined only about 35 per cent, the output per mine has increased. An average of about 1,200 men were employed in this production through the year. Among the new developments were the operations on Fish Creek, where little mining had been done previously. The pay streak on Goldstream Creek was also traced farther downstream.

The most extensive mining, as in 1909, was done on Goldstream Creek and its tributaries, Pedro and Gilmore creeks. Second in importance were the operations on lower Cleary Creek and on the Chatanika Flats. Fairbanks Creek was also the scene of much mining. It is estimated that 20 claims were worked on Fairbanks Creek, 13 on Esther Creek, 8 on Fish Creek, and 10 to 15 on other smaller creeks.

Innoko-Iditarod district.—In the summer of 1910 there were about 2,500 people in the Innoko-Iditarod district, and the gold output is estimated to have a value of about $825,000. The mining so far done has been confined chiefly to Flat Creek, a tributary of Otter Creek, to about 2 miles of Otter Creek, and to Willow Creek. Most of the mining in the Willow Creek basin has been confined to Happy Gulch, a headwater tributary of the main stream.

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Hot Springs district.—The Hot Springs district of the lower Tanana Valley had a very prosperous season. The largest production was derived from Sullivan and Cache creeks and their tributaries. Some good prospects were found on Hosiana Creek, in the eastern part of the district.

Rampart district.—The output of the Rampart district, lying adjacent to and north of the Hot Springs district, was considerably less than that of 1909. Little Minook Creek is still the chief producer in this field, Hunter Creek being second. The decrease in output is due in part to the fact that the hydraulic plant on Hoosier Creek was not operated in 1910. A steam-shovel plant was operated on Hunter Creek. It is estimated that 33 men worked on 18 claims in this district during the winter of 1909–10 and 42 men on 15 claims during the summer of 1910.

Salchaket region.—The production of the gold-bearing creeks of the Salchaket region in 1910 somewhat exceeded that of 1909. There was little mining activity in the Bonnifield district, except on Gold King Creek, where the hydraulic plant which has been in course of erection for several years was completed. Moose Creek, on which gold was first discovered in 1909, became a small producer in 1910.

Fortymile basin.—About 30 to 40 claims were worked in the Fortymile basin in 1910, and the gold output was about the same as in 1909. One large dredge was operated on Walker Fork near Poker Creek throughout the season and a smaller one for part of the summer on Fortymile River near the international boundary.

Seventymile River.—A small hydraulic plant was put up on Seventymile River near the falls, and in all from 12 to 15 claims were worked in this district. Mining continued in a small way on American, Woodchopper, Coal, Sam, Sunrise, and Fourth of July Creeks, all tributary to the upper Yukon. In this region 18 to 20 claims were worked in 1910, and the total gold production is estimated to have a value of $40,000.

Birch Creek.—The value of the gold output of the Birch Creek district is estimated at $225,000, which is the same as that of 1909. A small hydraulic plant on Eagle Creek was successfully operated throughout the summer, but the larger plant on Mammoth Creek was somewhat hampered by lack of water. There was also considerable staking of claims and prospecting in the Beaver Creek region but apparently no production of gold. It is estimated that during 1910 mining was done on 45 different claims in the Circle precinct.

Koyukuk region.—There was a considerable falling off in the gold output of the Koyukuk during 1910. This loss is largely chargeable to the decreased production of Nolan Creek, on which a few claims made a large gold output in 1909. A shaft was sunk for 335 feet on Wiseman Creek and an iron pipe was driven 30 feet deeper without reaching bedrock.

Lode mining in Yukon basin.—There have been many lode claims staked in the Yukon basin, but there was little actual prospecting and no developments of importance except in the Fairbanks and the Chandalar districts. The completion of a 10-stamp customs mill with full equipment at Chena in November, 1910, stimulated auriferous-lode development. Most of the actual lode gold production came from the smaller mill at Fairbanks, which was operated

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at intervals during the year. One arrastre was also operated a part of the summer season. From all the lode-mining operations it is estimated that probably about 200 tons were milled, yielding about $20,000 in gold, besides the concentrates and some values in silver.

The most important developments were on the Free Gold mine, located near the head of Cleary Creek. The main adit tunnel, which follows the ledge, is reported at the close of the year to have been driven over 630 feet.

An adit tunnel has been driven about 300 feet on the property of the Tanana Quartz & Hydraulic Co. On the Carlisle fracture nearby a shaft has been sunk about 50 feet and some crosscuts have been driven. Work has been continued by the Tolovana Mining Co. on its claims, on the Jupiter-Mars property in the same neighborhood, and on another group of claims on Willow Creek.

The property of the Pioneer Co. has been leased and some prospecting was accomplished. On the Soo claim a 125-foot adit tunnel has been driven. On the adjacent Waterbury claim a 55-foot shaft has been sunk. Ore was taken out of the Horton & Solomon claim on Wolf Creek.

Some open cuts were made on a lode, located on the divide between Wolf and Fairbanks creeks, which was discovered in 1909. In July and August some five ledges were discovered on Fairbanks Creek, the development work on which seems to have consisted chiefly of open cuts.

Two lodes on the divide between Vault and Dome creeks have been developed, and others have opened up in the vicinity.

The Hidden Treasure prospect, near the head of Little Eldorado, was developed by a 140-foot tunnel, and another in the same vicinity, said to be 5 feet wide, was opened by a 38-foot shaft.

Development work was done on the Whitman & Murray claim at the junction of Skooky and Twin creeks. An arrastre was built in 1910, with which considerable ore was milled.

Developments of auriferous quartz veins continued in the Chandalar district in 1910. Conditions of transportation were somewhat improved in this district by the completion of 70 miles of trail from Beaver on the Yukon to within 20 miles of Caro. In spite of the great cost of transportation, a small 3-stamp mill was erected on the Gold King claims on Big Creek, and some ore was put through. The Alaska-Chandalar Mining Co. continued development work on its property on Squaw Creek, which flows into Lake Creek. A 4-stamp mill was delivered at Beaver on the Yukon for this company during the summer and was to be sledded in during the winter of 1910–11.

KUSKOKWIM REGION.

The influx of population to the Innoko-Iditarod region has led to considerable prospecting in the adjacent parts of the Kuskokwim basin.

Some placer mining was done in 1910 on Bear Creek in the basin of the Toluksak River, tributary to the Kuskokwim from the east, about 20 miles above Bethel, and also on streams flowing into Goodnews Bay.

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NORTHWESTERN ALASKA.

The region here termed northwestern Alaska includes the Kobuk region, where a little placer mining was carried on in 1910; the Norton Bay region, where there was little or no productive mining; and the Seward Peninsula, which, in spite of its decreased output, is still second only to Fairbanks in the value of its annual gold output.

Seward Peninsula.—The value of the gold production of Seward Peninsula in 1910 is estimated to be $3,530,000, as compared with $4,302,000 in 1909. In spite of the decreased output, the mining industry, in view of the large amount of dead work accomplished, can be said to have had a prosperous year. Ten new dredges were built in 1910 on Seward Peninsula, of which 9 were operated for a part of the season, in addition to 7 dredges built in previous years, which were also operated. About $1,400,000 of gold was mined during the winter season and about $1,000,000 of this in the region immediately tributary to Nome. Of the total output, approximately $2,200,000 is to be credited to the Nome precinct, including the Solomon River region. The Fairhaven precinct probably made an output worth $500,000 and the Council somewhat less. The rest of the gold output is to be credited to the placer mines of the Kougarok and the Port Clarence precincts.

Three of the new dredges were located in the region tributary to Nome, making 5 in all for this district, of which 4 were operated in 1910. Four dredges were operated in the Solomon basin, of which 2 were built in 1910. Two new dredges and 3 old ones were operated in the Council region and 1 new one in the Casadepaga basin.

The Pioneer Co. purchased the Miocene ditch and used the water on various properties in the Nome region. Hydraulic plants were also operated on Bangor and Boulder creeks. The season's operations in the Kougarok precinct were specially successful because there was more water available than in any season for several years. The Taylor Creek Ditch Co., the largest operator in this district, was engaged in hydraulicking some bench gravels on the Kougarok River. The Fairhaven Ditch Co. also had a successful season in the northeastern part of the peninsula.

Kobuk region.—A small area lying adjacent to Shungnak Creek, in the middle part of the Kobuk Valley, has long been known to carry placer gold. The output from this district has had an annual value of $5,000 to $10,00. In 1909 a new field of gold placers was found in the lower part of the Kobuk basin.

The newly discovered placers lie in the basin of Squirrel River, which is tributary to Kobuk River from the north, about 70 miles from tidewater. Gold has been reported to occur in the gravels of eight or ten tributaries of Squirrel River, but mining has been entirely confined to one of them, Klery Creek.

ARIZONA.

By V. C. Heikes.

PRODUCTION.

There were 373 producing mines in Arizona in 1910, of which 44 were placers. The total output of gold, silver, copper, lead, and zinc was valued at $42,731,519, which was $1,321,504 less than in 1909,

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when 268 mines produced. The gold production was $3,149,366, against $2,737,500 in 1909. The silver output was 2,566,528 fine ounces, valued at $1,385,925, against 2,601,161 ounces, valued at $1,352,609, in 1909. The copper production was 297,491,151 pounds, valued at $37,781,376, or a decrease of 6,408,310 pounds and $1,725,554 in value from the output in 1909. The lead production decreased from 3,098,083 pounds, valued at $133,218, in 1909, to 2,696,998 pounds, valued at $118,668, in 1910; and the zinc output, figured as spelter, from 5,977,237 pounds, valued at $322,771, in 1909, to 5,484,899 pounds, valued at $296,189, in 1910. The increase in gold production may be credited to siliceous and copper ores, all other classes of ore yielding decreased quantities. Mohave, Cochise, and Maricopa County mines showed the largest increases in gold. Only $25,990 in gold was credited to placers in 1910, against $28,648 in 1909. The largest productions of silver, copper, and lead were made in Cochise County; zinc was produced in greatest quantity in Mohave County. Ores aggregating 178,685 tons and 17,860 tons of old tailing, treated at cyanide and amalgamation plants in 1910, produced gold and silver precipitate and bullion valued at $1,772,326, against a production from gold and silver plants of precipitate and bullion valued at $1,535,093 in 1909. At concentration mills 1,426,443 tons of ore produced 254,022 tons of concentrate, which was 59,281 tons less ore but 5,053 tons more concentrate than in 1909. The concentrates in 1910 containing gold, silver, copper, and lead were valued at $7,818,321, or a total average value of $30.78 per ton, as against a total value of $8,179,115 and an average value of $32.85 per ton in 1909. Concentrates shipped in 1910 carried marketable values in zinc. The ore shipped directly to the smelters aggregated 2,284,726 tons, valued at $33,115,707, for the gold, silver, copper, lead, and zinc, and it averaged $14.47 per ton. In 1909 the value for the same metals contained in shipping ore was $34,308,396, at an average of $15.70 per ton. The metal contents of 287,573 tons of old slag are included in the total recovery from crude ore. The statement of production for 1909 and 1910, showing increase and decrease and valued at each year's average commercial prices, is as follows:

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1909 and 1910.

Metals.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	132,426.56	$2,737,500	152,350.58	$3,149,366	+19,924.02	+ $411,866
Silver. .....do....	2,601,161	1,352,604	2,566,528	1,385,925	− 34,633	+ 33,321
Copper.....pounds..	303,899,461	39,506,930	297,491,151	37,781,376	−6,408,310	−1,725,554
Lead.....do....	3,098,083	133,218	2,696,998	118,668	− 402,085	− 14,550
Zinc.....do....	5,977,237	322,771	5,484,899	296,184	− 492,338	− 26,587
Total.....	.....	44,053,023	.....	42,731,519	.....	−1,321,504

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The production of ore and its content in Arizona for seven years is as follows:

Tons of ore sold or treated in Arizona in 1904–1910, and total content of gold, silver, and associated metals.

Years.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1904	2,805,938	168,274.00	2,314,940	199,481,044	1,779,967	.....	$29,816,840
1905	2,678,059	135,412.00	2,605,712	228,418,679	4,940,910	140,000	40,246,861
1906	3,585,089	143,416.55	3,026,438	266,831,864	5,638,735	.....	56,812,355
1907	3,567,133	126,612.52	2,511,897	264,879,489	4,660,684	228,490	55,511,560
1908	3,696,938	117,646.89	2,808,450	285,858,133	3,008,583	678,446	41,611,975
1909	4,029,955	132,426.56	2,601,161	303,899,461	3,098,083	5,977,237	44,053,023
1910	3,914,969	152,350.58	2,566,528	297,491,151	2,696,998	5,484,890	42,731,519

All of the large copper smelting plants in Arizona were in operation in 1910—the two smelters at Douglas, in Cochise County; three at Clifton and Morenci, in Greenlee County; two in Yavapai County, at Humboldt and Jerome; and two in Gila County, near Globe. A large copper smelter at Hayden, in Pinal County, was under construction. The small plant of the Arizona-United at Johnson was idle, and the Benson plant was reported to be preparing to operate. Ore buyers from Oklahoma, Colorado, and Kansas bought zinc. Some silver bullion was shipped to eastern and western points, but the bulk of the lead ore went to lead plants at El Paso, Tex., and some to Colorado and California. The bulk of the copper ores was treated at copper plants in Arizona.

ORE PRODUCTION IN 1910.

The ores mined and treated decreased from 4,029,955 tons in 1909 to 3,914,969 tons in 1910, and the average value from $10.92 to $10.91 per ton. The decrease of 114,986 tons of ore is small in comparison with the large tonnage of ore treated, and was caused largely by the decrease in tonnage of copper ores sold or treated from 3,741,713 tons in 1909 to 3,644,495 tons in 1910, of lead ore from 27,658 tons to 6,240 tons, and of copper-lead ore from 16,810 tons to 1,193 tons. The corresponding tonnage of siliceous ores increased from 237,078 tons in 1909 to 255,391 tons in 1910, and of zinc ores from 6,696 tons to 7,650 tons. The average yield per ton of gold and silver in siliceous ore in 1910 was $8.65, against $7.31 in 1909; in copper ore, 59 cents, against 48 cents in 1909; in lead ore, $15.60, against $6.39 in 1909; in copper-lead ore, $19.23, against $18.47 in 1909; and in zinc ore, $5.90, against $8.78 in 1909. The total tonnage by kinds of ore sold or treated in Arizona in 1910 is shown in the following table:

Subdivision of tonnage of ore sold or treated in Arizona in 1910, by counties, in short tons.

Counties.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	62,305	1,229,027	2,773	.....	177	1,294,282
Coconino and Maricopa	12,289	1,618	.....	.....	.....	13,907
Gila	338	311,713	4	.....	2	312,057
Graham	.....	.....	18	.....	.....	18
Greenlee	6,393	1,554,648	126	.....	.....	1,561,167
Mohave	90,013	847	790	7,633	.....	99,283
Pima	31	176,722	34	.....	888	177,675
Pinal	164	57	17	.....	1	239
Santa Cruz	359	173	221	17	23	793
Yavapai	51,644	363,338	2,224	.....	102	417,308
Yuma	31,855	6,352	33	.....	.....	38,240
Total	255,391	3,644,495	6,240	7,650	1,193	3,914,969
Value per ton in gold and silver	$8.65	$0.59	$15.60	$5.90	$19.23	$1.15

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GOLD.

The increased output of gold was from siliceous and copper ores. Decreased production was obtained from placers, lead, zinc, and copper-lead ores. Mohave, Yavapai, Cochise, and Yuma County mines produced most of the gold. The greatest increase was in Mohave County, where the Gold Road and the Tom Reed mines made larger yields than formerly. Gila, Pima, Pinal, Yavapai, and Yuma counties fell short of their usual output. In 1910 mines of the Territory produced 152,350.58 ounces of gold, valued at $3,149,366. Compared with the figures of 1909, this indicated an increase of $411,866. Gold extracted from ores and tailings by the amalgamation and cyanide processes represented about half the total output, and aggregated 84,173.85 ounces, averaging $8.85 per ton. In 6 districts of Yavapai County and 2 of Mohave and Yuma counties, mills were equipped to save concentrate, besides the gold and silver bullion. Iron sulphide concentrate predominated, carrying high gold and small silver values and a little copper and lead. Mills equipped only for concentration yielded concentrate containing principally copper and a little gold. The total output from concentrate was 9,955.76 ounces of gold, averaging 81 cents per ton. The concentrate in 1909 contained 11,619.18 ounces of gold and averaged 96 cents per ton. Copper concentrates were produced in largest quantities at Clifton and Morenci, in Greenlee County (formerly a part of Graham County), and at Globe, in Gila County. In both counties the gold content was insignificant. Smelting ores shipped directly to the smelters in 1910 contained 56,443.59 ounces of gold, which averaged 51 cents per ton, as against a yield in 1909 of 51,652.09 ounces of gold, averaging 49 cents per ton. Placer gold production decreased from $30,937 in 1908 to $28,648 in 1909, and to $25,990 in 1910. Yavapai, Yuma, and Pima County placers continued to be the largest producers. Small dredges have been erected on Lynx Creek, in the Walker district, and in French Gulch, a small intermittently flowing tributary of Hassayampa River. None of them produced in 1910.

Source of gold production in Arizona, by kinds of ore in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	25.11	2,339.54	25,342.19	699.49	.....	12.82	28,419.15
Coconino and Maricopa	53.55	3,115.15	6.20	.....	.....	.....	3,174.90
Gila	10.35	84.62	1,125.24	.12	.....	.12	1,220.45
Graham	.....	.....	.....	.05	.....	.....	.05
Greenlee	45.52	1,236.06	996.19	53.47	.....	.....	2,331.24
Mohave	.....	53,751.61	26.37	322.72	1,289.74	.....	55,390.44
Pima	115.52	13.01	61.19	2.50	.....	48.78	241.00
Pinal	.....	94.83	1.73	.01	.....	.13	96.70
Santa Cruz	41.85	64.25	18.43	3.71	.....	.35	128.59
Yavapai	589.31	16,921.09	24,628.07	518.02	.....	38.81	42,665.30
Yuma	406.06	17,774.01	501.79	.....	.....	.....	18,682.76
Total	1,257.27	95,395.07	52,707.40	1,600.09	1,289.74	101.01	152,350.58

SILVER.

In 1910 the yield of silver was 2,566,528 ounces, valued at $1,385,925, a decrease of 34,633 ounces in quantity, but an increase of $33,321 in value. Cochise County produced in 1910 about half

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the total quantity of silver, or 1,208,274 ounces, three-fourths of which was recovered from the copper ores mined at Bisbee. The total silver production from copper ores mined in 1910 aggregated 1,934,363 ounces against 1,830,998 ounces in 1909; from siliceous ores, 440,126 ounces against 407,757 ounces in 1909; from lead ore, 119,034 ounces against 234,709 ounces in 1909; from zinc ore, 34,227 ounces against 44,841 ounces in 1909; and from copper-lead ore, 38,611 ounces against 82,673 ounces in 1909. Crude ores treated at smelters yielded over nine-tenths of the total silver, or 2,402,229 ounces, averaging 1.05 ounces per ton. In 1909 smelting ores contained 2,204,069 ounces of silver, averaging 1.01 ounces per ton. The concentrates produced at concentrating mills and shipped to smelters contained 96,894 ounces of silver, or an average of 0.4 of an ounce per ton, against a yield of 135,657 ounces of silver, averaging 0.54 of an ounce per ton in 1909. Silver from ores treated by amalgamation and the cyanide process aggregated 59,812 ounces, an average of 0.33 of an ounce per ton. This is a notable decrease in 1910, since 258,029 ounces represented the yield in 1909.

Source of silver production in Arizona, by kinds of ore in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	5	149,275	980,869	66,915	.....	11,210	1,208,274
Coconino and Maricopa	6	1,327	1,396	.....	.....	.....	2,729
Gila	3	8,502	165,636	18	.....	447	174,606
Graham	.....	.....	.....	145	.....	.....	145
Greenlee	7	82,904	63,704	445	.....	.....	147,060
Mohave	.....	39,139	6,461	32,618	34,227	.....	112,445
Pima	16	3	84,371	1,333	.....	23,632	100,355
Pinal	.....	98	3,883	5,779	.....	196	9,956
Santa Cruz	12	76,601	3,110	2,257	.....	1,140	83,219
Yavapai	56	74,255	614,829	8,576	.....	1,986	699,702
Yuma	62	7,849	10,095	948	.....	.....	18,947
Total	167	440,126	1,934,363	119,034	34,227	38,611	2,566,628

COPPER.

The yield of copper amounted to 297,491,151 pounds, valued at $37,781,376, in 1910. As compared with the figures of 1909, this showed a decrease of 6,408,310 pounds, which is credited largely to Gila, Pima, and Pinal counties. The greatest increase was made in Cochise County, and the next important gain was in Yavapai County. Cochise County mines continue to be the largest producers of copper, with 145,310,623 pounds to their credit in 1910, against 140,810,472 pounds in 1909. The crude shipping ores treated at smelters in 1910 yielded about eight-tenths of the total, or 237,774,349 pounds, averaging 104.07 pounds per ton. The output of similar ores in 1909 was 244,040,367 pounds, averaging 111.72 pounds per ton. From old smelter slag re-treated there were recovered 287,655 pounds of copper, as against 8,189,356 pounds in 1909; and from old tailings there were 4,089 pounds, against 169,008 pounds recovered in 1909. Concentrates produced at milling plants, largely in Greenlee, Gila, and Pima counties, yielded about one-fifth of the total copper, and aggregated 59,425,058 pounds, or an average of 233.93 pounds per ton. There was very little change from the output of 1909, when 59,859,094 tons

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were produced, averaging 240.42 pounds per ton. Copper ores were mined in largest quantities in Cochise, Greenlee, Yavapai, Gila, and Pima counties, given in the order of importance, and aggregated 3,644,495 tons, which yielded an average of 81.42 pounds per ton. Siliceous ores, aggregating 255,391 tons, yielded an average of 2.54 pounds per ton; lead ores, aggregating 6,240 tons, yielded 5.73 pounds per ton; copper-lead ores, aggregating 1,193 tons, yielded 56.75 pounds per ton, and were mined in Cochise, Mohave, Pima, Pinal, Santa Cruz, and Yavapai counties.

Source of copper production in Arizona by kinds of ore in 1910, by counties, in pounds.

County.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Cochise	603,730	144,673,083	27,177	6,633	145,310,623
Coconino and Maricopa	17	67,510	.....	.....	67,527
Gila	6,081	31,323,884	42	215	31,330,222
Greenlee	319	72,876,926	849	.....	72,878,094
Mohave	1,040	524,757	3,956	.....	529,753
Pima	.....	6,088,717	205	48,391	6,137,313
Pinal	229	10,800	179	153	11,361
Santa Cruz	10,081	29,607	536	2,037	42,261
Yavapai	26,623	40,784,853	2,805	10,275	40,824,556
Yuma	228	359,213	.....	.....	359,441
Total	648,348	296,739,350	35,749	67,704	297,491,151

LEAD.

The production of lead decreased from 3,098,083 pounds, valued at $133,218, in 1909, to 2,696,998 pounds, valued at $118,668, in 1910. Increases in lead are credited to the mines of Mohave, Santa Cruz, and Pinal counties, and the decreases mentioned were caused by the lessened production of the mines in Cochise, Yavapai, Pima, Yuma, and Gila counties. Ore shipped to smelters contained 2,393,610 pounds, or about nine-tenths of the total lead. Concentrates produced at mills in 4 counties yielded 300,268 pounds of lead from 2,257 tons of concentrates. Siliceous or dry ore contained an average of 0.68 of a pound per ton; lead ore, 253.91 pounds per ton; zinc ore, 65.66 pounds per ton; copper-lead ore, 360.56 pounds per ton.

Source of lead production in Arizona by kinds of ore in 1910, by counties, in pounds.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	66,848	.....	989,006	.....	120,562	1,176,416
Gila	.....	2,994	2,603	.....	505	6,102
Graham	.....	.....	20,824	.....	.....	20,824
Greenlee	.....	.....	31,576	.....	.....	31,576
Mohave	1,780	.....	235,957	502,354	.....	740,091
Pima	68	41	12,154	.....	277,644	289,907
Pinal	30	.....	12,092	.....	959	13,081
Santa Cruz	5,169	1,981	93,014	.....	7,336	107,500
Yavapai	101,105	.....	140,659	.....	23,147	264,911
Yuma	35	.....	46,555	.....	.....	46,590
Total	175,035	5,016	1,584,440	502,354	430,153	2,696,998

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ZINC.

Figured as spelter, the zinc output reported by producers aggregated 5,484,899 pounds, valued at $296,184, in 1910, as against a yield of 5,977,237 pounds, valued at $322,771, in 1909. The decrease was caused by the closing of the mills connected with the Tombstone mines in Cochise County. The output of zinc increased in Mohave County, and Santa Cruz County added to the increase with a production of zinc ore. No concentrates containing zinc were reported in 1910.

MINING INDUSTRY IN ARIZONA IN 1910.

Although the year 1910 was not a record breaker, yet the production of copper in Arizona exceeded that of Montana and placed Arizona in the lead. The year was marked by increased and important mine development, especially in the low-grade copper mines near Globe, in Gila County, and Ray, in Pinal County, which are soon to produce. The Miami Co., near Globe, expected to start its mill early in 1911, and to ship the concentrate to Cananea, Mexico, for reduction. The shutting down of the Imperial mines at Silverbell and of the smelter at Sasco was a blow to all mining activity in the southern portion of Arizona, but the company has continued its explorations of the disseminated copper deposits in porphyry and granite, the results of which are reported to have been satisfactory. The Yavapai County and western Arizona gold belts suffered less than the copper fields, but no large new producers were brought in. At the King of Arizona mine, in Yuma County, the mill was closed in September, as the grade of ore was too low to work. The property has produced more than $200,000 a year for 10 or 15 years. In the same district the Gold Star Mining Co. reported to the Territorial auditor an output of $333,590.32. This company has been treating by the cyanide process about 100 tons of ore per day. The mine is worked in a large porphyry dike through which run streaks of high value. The 200-ton mill at the Commonwealth mine at Pearce was destroyed by fire in April, but in November another cyanide and leaching plant of a capacity of 125 tons was in operation. The mines in the Tombstone district were worked under great disadvantage during 1910, as an increased flow of water made necessary new pumps and other expensive machinery. The notable success of the Golconda mine led to active prospecting for new zinc properties and to the reopening of the old silver mines in which the ores turned to zinc at water level. The success of the Golconda has stimulated prospectors and small miners throughout the Cerbat Mountains, and a good deal of work was accomplished during 1910. The improvement in the total gold output was due almost entirely to the strikingly increased production from the Gold Road and the Tom Reed mines in Mohave County, which more than offset a large decrease in Yuma County. Arizona shared in part the dry-placer excitement which started in Sonora, Mexico, and was due in large measure to the successful operation of the Quenner pulverizer. The Arizona Power Co., at Fossil Creek, in Yavapai County, was unable to furnish sufficient power over its first wires, and another line is nearing completion along the other side of the mountain directly from Fossil Creek to

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Jerome. The smelter of the United Verde Copper Co. will use a large portion of this added power. Extensive additions and improvements have been planned to this already large smelting plant, or a site may be selected for a new plant. The camps in Yuma County, along the line of the Arizona & California Railroad, showed a good deal of activity. The Clara Consolidated Copper Co. has a smelter at the new camp of Swansea, connected with the Arizona & California Railroad by its own railroad from Bouse. This smelter has been used for little besides test work. The resumption of work at the Humboldt smelter, in Yavapai County, furnished a near-by market for this ore. Something of the impetus that this custom smelter has given to the small miner of Arizona can be judged from the fact that during the first six months of its renewed operations $450,000 worth of copper bullion was reported to have been shipped to New York. The mining business as a whole has a very favorable outlook for 1911 in this county. Improvement was made in the Calumet & Arizona smelter, at Douglas, and at the Copper Queen plans and preparations have been made for a reverberatory addition to its Douglas plant.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1910, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
Cochise	28,419.15	$587,476	1,208,274	$652,468	145,310,623	$18,454,449
Coconino and Maricopa	3,174.90	65,631	2,729	1,474	67,527	8,575
Gila	1,220.45	25,229	174,696	94,336	31,330,222	3,978,938
Graham	.05	1	145	78	.....	.....
Greenlee	2,331.24	48,191	147,060	79,413	72,878,094	9,255,518
Mohave	55,390.44	1,145,022	112,445	60,720	529,753	67,279
Pima	241.00	4,982	109,355	59,052	6,137,313	779,439
Pinal	96.70	1,999	9,956	5,376	11,361	1,443
Santa Cruz	128.59	2,658	83,219	44,938	42,261	5,367
Yavapai	42,665.30	881,970	699,702	377,839	40,824,556	5,184,719
Yuma	18,682.76	386,207	18,947	10,231	359,441	45,649
Total	152,350.58	3,149,366	2,566,528	1,385,925	297,491,151	37,781,376

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1910, by counties.

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Cochise	1,176,416	$51,762	.....	.....	$19,746,155
Coconino and Maricopa	.....	.....	.....	.....	75,680
Gila	6,102	269	.....	.....	4,098,772
Graham	20,824	916	.....	.....	995
Greenlee	31,576	1,389	.....	.....	9,384,511
Mohave	740,091	32,564	5,474,046	$295,598	1,601,183
Pima	289,907	12,756	.....	.....	856,229
Pinal	13,081	576	.....	.....	9,394
Santa Cruz	107,500	4,730	10,853	586	58,279
Yavapai	264,911	11,656	.....	.....	6,456,184
Yuma	46,590	2,050	.....	.....	444,137
Total	2,696,998	118,668	5,484,899	296,184	42,731,519

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Tonnage of milling and smelting ore and concentrates, and quantity of gold and silver contained in bullion, produced in Arizona in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Cochise	169	[a] 444.57	[a] 18,404	624
Coconino and Maricopa	12,284	3,079.87	1,114	.....
Gila	66	64.00	19	106,037
Graham	.....	.....	.....	.....
Greenlee	1,105	146.02	44	1,306,783
Mohave	89,839	53,695.73	26,371	267
Pima	30	12.99	3	4,782
Pinal	146	74.45	20	.....
Santa Cruz	50	43.47	17	.....
Yavapai	43,217	8,919.32	6,022	7,950
Yuma	31,779	17,693.43	7,798	.....
Total	178,685	84,173.85	59,812	1,426,443

County.	Concentrates produced.					Total value of concentrates.
	Quantity.	Gold.	Silver.	Copper.	Lead.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Cochise	78	163.16	7,892	302	17,275	$8,433
Coconino and Maricopa	5	18.62	211	17	.....	501
Gila	36,261	370.90	48,378	6,955,796	.....	917,177
Graham	.....	.....	.....	.....	.....	.....
Greenlee	214,933	124.20	4,612	52,135,013	.....	6,626,205
Mohave	104	35.36	1,365	1,026	89,706	5,545
Pima	566	15.57	465	297,785	.....	38,392
Pinal	.....	.....	.....	.....	.....	.....
Santa Cruz	.....	.....	.....	.....	.....	.....
Yavapai	2,074	9,210.34	33,935	35,108	193,252	221,682
Yuma	1	17.61	36	11	35	396
Total	254,022	9,955.76	96,894	59,425,058	300,268	7,818,321

County.	Crude ore to smelter.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cochise	1,275,629	27,786.31	1,181,973	145,310,321	1,159,141	.....	$19,718,072
Coconino and Maricopa	1,623	22.86	1,398	67,510	.....	.....	9,801
Gila	201,945	775.20	125,996	24,086,853	6,102	.....	[b] 3,180,045
Graham	18	.05	145	.....	20,824	.....	995
Greenlee	253,279	2,015.50	142,397	20,743,081	31,576	.....	2,754,318
Mohave	9,177	1,659.35	84,709	528,727	650,385	5,474,046	471,407
Pima	172,863	96.92	108,871	5,839,528	289,907	.....	815,169
Pinal	93	22.25	9,936	11,361	13,081	.....	7,845
Santa Cruz	702	42.86	82,981	42,179	104,380	10,853	[c] 56,500
Yavapai	362,936	23,456.64	652,772	40,785,359	71,659	.....	[d] 6,036,196
Yuma	6,461	565.66	11,051	359,430	46,555	.....	65,359
Total	2,284,726	56,443.59	2,402,229	237,774,349	2,393,610	5,484,899	33,115,707

[a] Includes bullion from 17,869 tons of old tailings.
[b] Includes value of 300 ounces of silver and 287,573 pounds of copper from old slag re-treated.
[c] Includes value of 0.41 of an ounce of gold, 209 ounces of silver, 82 pounds of copper, and 3,120 pounds of lead from old slag.
[d] Includes value of 519.69 ounces of gold, 6,917 ounces of silver, and 4,089 pounds of copper from old tailings.

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Tonnage of ore sold or treated, number of deep mines producing, and value of ores in 1909 and 1910, by counties.

County.	Ore sold or treated (short tons).		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	1910	Increase (+) or decrease (−).	1909	1910	1909	1910	1909	1910
Cochise	1,294,282	+ 72,187	38	37	$16.11	$15.25	$1.03	$0.96
Coconino and Maricopa	13,907	+ 10,063	5	8	6.47	5.36	6.38	4.74
Gila	312,057	−133,631	22	44	11.75	13.13	.24	.38
Graham	18	− 32	1	1	27.78	55.28	4.44	4.39
Greenlee	1,561,167	− 5,772	22	23	6.01	6.01	.05	.08
Mohave	99,283	+ 68,461	29	40	23.56	16.12	12.86	12.14
Pima	177,675	−120,948	29	25	6.26	4.80	.37	.34
Pinal	239	− 36,405	15	15	4.12	39.30	1.72	30.85
Santa Cruz	793	− 1,164	10	21	13.27	72.39	3.31	58.92
Yavapai	417,308	+ 93,819	48	87	18.80	15.44	3.83	2.99
Yuma	38,240	− 61,564	24	28	8.05	11.39	7.28	10.15
Total	3,914,969	−114,986	243	329	10.92	10.91	1.01	1.15

[a] Value per ton, placer product excluded.

Number of mines in Arizona classified by chief products in 1910.

County.	Total mines producing.	Gold placer mines.	Deep mines.											
			Gold.	Silver.	Copper.	Gold, silver.	Gold, silver, copper.	Silver, copper.	Silver, copper, lead.	Gold, silver, lead.	Silver, lead.	Gold, silver, copper, lead.	Gold, silver, lead, zinc.	Gold, silver, copper, lead, zinc.
Cochise	38	1	....	....	2	5	11	4	1	....	1	13	....	....
Coconino and Maricopa	11	3	....	....	....	4	3	1	....	....	....	....	....	....
Gila	46	2	....	....	4	5	16	14	1	....	....	4	....	....
Graham	1	....	....	....	....	....	....	....	....	1	....	....	....	....
Greenlee	24	1	....	....	4	6	6	3	....	2	1	1	....	....
Mohave	40	....	2	....	....	13	5	1	....	12	1	5	1	....
Pima	29	4	....	....	....	2	11	2	1	[a] 2	[a] 2	5	....	....
Pinal	15	....	....	....	....	5	3	2	2	....	1	2	....	....
Santa Cruz	22	1	....	....	....	1	3	1	1	....	3	11	....	[b] 1
Yavapai	104	17	....	1	....	31	33	1	....	5	....	16	....	....
Yuma	43	15	....	....	1	7	[c] 15	2	....	....	2	1	....	....
Total	373	44	2	1	11	79	106	31	6	22	11	58	1	1

[a] One contains no silver. [b] Contains zinc only. [c] Two contain no silver.

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PRODUCTION BY COUNTIES.

COCHISE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Cochise County, Ariz., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	24,040.00	$496,951	28,419.15	$587,476	+ 4,379.15	+ $90,525
Silver.....do....	1,454,390	756,283	1,208,274	652,468	− 246,116	− 103,815
Copper.....pounds..	140,810,472	18,365,361	145,310,623	18,454,449	+ 4,500,151	+ 149,088
Lead.....do....	2,004,018	86,173	1,176,416	51,762	− 827,602	− 34,411
Zinc.....do....	713,116	38,508	.....	.....	− 713,116	− 38,508
Total.....	.....	19,683,276	.....	19,746,155	.....	+ 62,879

The production in Cochise County of 1,294,282 tons of ore in 1910 was made by 37 operators, 1 operator less than reported production in 1909, when 1,222,095 tons of ore were produced. The total value of the metals from this ore was $19,746,155, against $19,683,276 in 1909, a gain of $62,879. The total average value per ton decreased from $16.11 in 1909 to $15.25 in 1910; the gold and silver value of this ore, which in 1909 was $1.03, decreased to $0.96. Smelters at Douglas treated the largest part of the total tonnage, which consisted mainly of copper ore, the yield of mines in the Warren district. The lead ore was treated at the smelter near El Paso, Tex. Gold and silver bullion recovered from the milling ores was shipped east and to San Francisco. The crude ores of shipping grade treated at the smelters aggregated 1,275,629 tons and contained $574,394 in gold, 1,181,973 ounces of silver, 145,310,321 pounds of copper, and 1,159,141 pounds of lead, having a total value of $19,718,072 and an average value of $15.46 per ton. This value per ton is slightly less than the average value in 1909, when 1,160,056 tons of ore shipped to smelters averaged $16.72 per ton. A decreased quantity of ore was treated at concentration mills in 1910, owing to the reduced production of mines at Tombstone. Only 624 tons of ore were concentrated, producing 78 tons of concentrate, which contained $3,373 in gold, 7,892 ounces of silver, 302 pounds of copper, and 17,275 pounds of lead, in all valued at $8,433, an average value of $108.11 per ton. The quantity of ore treated in 1909 aggregated 18,928 tons, yielding 2,169 tons of concentrate, and averaged in value $51.75 per ton. At amalgamation and cyanide mills a considerable quantity of old tailings and a small quantity of ore were treated, aggregating 18,029 tons, which yielded $9,190 in gold and 18,404 ounces of silver, having a total value of $19,128, and an average recovery value of $1.06 per ton. No zinc was recovered from any of the ores treated, and only 1 placer production was reported in 1910.

California district.—The Scott & Crawford mine made a shipment of ore to smelters in 1910. The ore shipped contained silver and lead. There were five properties producing in 1909.

Cochise or Johnson district.—The output reported by three deep-mine operators aggregated 3,836 tons of smelting ore, which yielded $596

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in gold, 13,406 ounces of silver, 271,003 pounds of copper, and 119,778 pounds of lead, valued in all at $47,522, an average value of $12.39 per ton. The principal mines producing were the Republic and two others reported by companies developing them.

Dos Cabezos district.—The operators of deep mines produced gold and silver ore, half of which was shipped to the smelter, and the remainder was treated at an amalgamation plant and produced gold bullion.

Teviston district.—In 1910 the operator of one property reported the shipment of several small test lots of ore carrying gold, silver, and copper.

Tombstone district.—The ore produced by 13 deep-mine operators aggregated 5,249 tons. The larger part, or 4,619 tons, was shipped directly to the smelters, yielding 1,061.69 ounces of gold, 116,520 ounces of silver, 31,163 pounds of copper, and 305,876 pounds of lead. Practically the entire remainder of the ore, or 624 tons in quantity, produced 78 tons of concentrate, which contained gold, silver, copper, and lead. No zinc concentrate was made in 1910 at the mill of the Tombstone mine. However, it was the largest producer of lead-silver ore and concentrate carrying a little gold and copper. The Herschell, the Bunker Hill, and the Royal Guard mines made important productions.

Turquoise district.—Reports from 9 deep mines and 1 placer gave an aggregate production of 93,929 tons of ore, containing $34,925 in gold, 89,782 ounces of silver, and 4,767,688 pounds of copper, valued in all at $688,904, or an average value of $7.33 per ton. This includes the treatment of 17,860 tons of old tailings, which produced bullion high in silver and containing some gold. Of the total tonnage, 75,932 tons were shipped to smelters at Douglas, Globe, and Clifton. Part of the ore was used as converter lining and some of it was valuable as fluxing ore. The principal producer of copper ore was the Germania property at Courtland. According to the annual published statement of the operating company, all development work at the April Fool shaft was stopped in February, owing to lack of encouragement underground. Development work was also discontinued in February on the 311-foot and 500-foot levels from the Germania shaft. These levels were allowed to fill with water, and attention was directed to stoping and development on the upper levels. Shipments were commenced in February to the smelter at Douglas, approximately 100 tons of oxide ore per day being shipped, until the property was closed down in the interests of economy and curtailment in September. The Courtland Exploration as a whole has been discouraging, but it is felt that there is ground south and west of the Germania shaft that will justify development done above the 261-foot level. This work can be done when stoping of ore now developed is resumed. At the time of the closing down, the pumps were removed from the shaft and at the present writing the water appears to have reached its permanent level at a point 7 feet below the 311-foot level. The cyanide mill of the Commonwealth mine was destroyed by fire and old tailings only were treated during 1910.

Warren district.—Seven companies in 1910 reported the yield of 1,191,124 tons of ore, which contained $525,471 in gold, 980,207 ounces of silver, 140,285,296 pounds of copper, and 713,471 pounds of lead, having a total value of $18,896,059, or an average value of

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$15.86 per ton. All of this ore was of shipping grade, and most of it was treated at the Douglas smelters. The ore containing lead, mined and shipped by lessees, was treated at the El Paso (Tex.) smelter. Development in the Calumet & Arizona [1] mine consisted of 30,848 feet of openings in 1910, as against 27,562 feet in 1909. The only shaft sinking was done on the Irish Mag, where the shaft was sunk to a total depth of 1,395 feet. Production decreased from 27,345,079 pounds of fine copper in 1909 to 26,522,667 pounds in 1910, and the tonnage of smelting ore yielding this copper from 290,360 tons to 281,043 tons. At the Superior & Pittsburg [2] mine development consisted of 27,847 feet in 1910, as against 26,027 feet in 1909. The Junction shaft was sunk 219 feet and is now 1,774 feet deep, and the Briggs shaft was sunk 163 feet, making it 1,300 feet deep. It is reported that the Cole shaft was shut down in September for the interests of economy and curtailment. Production of copper from this mine increased from 24,440,410 pounds in 1909 to 26,183,146 pounds in 1910, and the tonnage of smelting ore from 222,416 tons to 227,114 tons. The smelter at Douglas, belonging to the Calumet & Arizona Co., was operated after September with a curtailment of approximately 15 per cent of its capacity, keeping in blast its three 500-ton furnaces and closing the 300-ton furnace. Its converters were operated at full capacity. The use of barren silica for acid converter lining has been discontinued and siliceous ore containing small quantities of copper, silver, and gold, valued at $6.20 per ton, from the Superior mine near Lordsburg, N. Mex., has been used in its place. Experiments with one of the small furnaces were under way in December trying raw sulphide smelting of the ores. Developments in the Copper Queen [3] mine consisted of 59,806 feet in 1910, as against 60,320 feet in 1909. Shaft sinking aggregated 408 feet. A larger proportion of the total footage was driven for prospecting purposes than during 1909, but, as before, a certain amount of this footage was for the purpose of working ground already exposed. This exploratory work has been carried on most actively in the southwest section of the property, and in looking for disseminated ore in the porphyries of Sacramento Hill. The gross content in 1910 of 596,193 tons of ore and precipitates was 12,430.27 ounces of gold, 608,097 ounces of silver, 76,428,908 pounds of copper, and 696,118 pounds of lead. This output shows a very decided decrease in copper output, but more gold, silver, and lead than was produced in 1909, when 596,235 tons of ore and precipitates contained 8,674.28 ounces of gold, 601,809 ounces of silver, 84,443,529 pounds of copper, and 437,601 pounds of lead. The ore containing lead was shipped to El Paso, Tex., and the copper ores were treated at Douglas. There were operated during 1910 an average of 9.1 blast furnaces at an average of 345 tons of charge per furnace day.

COCONINO COUNTY.

Two operators in the Francis district of this county reported production of copper ore in 1910. The most extensive operations were carried on by the Consolidated Arizona Co., which shipped the ores containing silver and copper to its smelter at Humboldt, Ariz.

[1] Annual Report, 1910, Calumet & Arizona Mining Co.
[2] Annual Report, 1910, Superior & Pittsburg Copper Co.
[3] Annual Report, 1910, Phelps, Dodge & Co.

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GILA COUNTY.

In 1910 the production of ore from Gila County aggregated in value $4,098,556, a decrease from the production of 1909, when the total value reached $5,235,520. Altogether the ores mined in 1910 yielded $25,015 in gold, 174,693 ounces of silver, 31,330,222 pounds of copper, and 6,102 pounds of lead. Forty-four deep-mine operators reported a production of 312,057 tons of ore, as against half the number of operators with an output of 445,688 tons in 1909. The decrease in the production of ore is attributed to the consolidation of interests and to the preparations made for working the properties on a larger scale by corporations than had previously been done by numerous lessees. Two-thirds of the ore, which contained chiefly copper, was treated at the Old Dominion and the Copper Queen smelters. A small quantity of lead ore, produced in the vicinity of Globe, was shipped to the El Paso, Tex., smelter. The total smelting ore, aggregating 201,945 tons, contained $16,025 in gold, 125,996 ounces of silver, 24,086,853 pounds of copper, and 6,102 pounds of lead, valued in all at $3,143,361, with an average value of $15.57 per ton. Ore aggregating 187,090 tons in 1909 and containing the same metals, was treated at smelters, averaging $23.70 per ton. The milling ores aggregated 106,037 tons, yielding 36,261 tons of concentrate, which contained $7,667 in gold, 48,378 ounces of silver, and 6,955,796 pounds of copper, having a total value of $917,177, or an average value of $25.29 per ton of concentrates. Concentrates aggregating 40,399 tons were produced in 1909, averaging $19.76 per ton. One amalgamation mill treated ore from which gold and silver bullion was produced. The slag from the old smelter dumps at Globe was re-treated at the Old Dominion smelter and the metallic contents bring the total value of crude ore, and slag resmelted, to $3,180,045. Reports were received from 2 placer operators. The Old Dominion smelter turned out more than 2,225,000 pounds of copper a month, which is somewhat less than its full capacity. The Arizona-Commercial operated its matting plant for four months, treating 200 tons or more a day. In May the plant was closed and development was continued at the mine. The operators of the Warrior mines shipped at the rate of 100 tons a day to El Paso and Globe, and the Superior & Boston was shipping 50 tons of 9 per cent copper ore a day. An unusual amount of work was done by churn drill as well as by drifting on large low-grade copper deposits at the Miami, the Inspiration, and the Keystone mines. From the annual published report for 1910 of the Miami Co. the following statements are taken:

The land holdings now comprise 1,122 acres. Of the total 222 acres are classified as mineral bearing, and contiguous to this is a tract of 555 acres on which are built the mill and power plant, and a large portion of which is particularly well adapted to the stacking of tailing. The balance, 345 acres, is made up of the land purchased for water development.

Mine development has been carried on steadily throughout 1910 along the lines originally adopted. During the year a total of 31,641 feet of shafts, drifts, and raises was driven. This brings the total length of underground working to 78,388 feet. The underground work for the year yielded 116,248 tons of ore which were added to the stock pile, thus providing a total tonnage of 251,009 tons already broken and available for the mill. To handle this, two raises have been put up from the 420-foot level to tap the stock pile at the surface and provide an easy means of handling it to the main shaft. * * * The mill building and its accessories have been completed and four of the six sections completely equipped for operation. * * * By means

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of drill holes and underground work 58 acres of the ground have been explored and classified as mineral bearing. Of this, 15 acres are considered too low grade to be classed as ore, and in the remainder we now estimate that there are fully proven 18,000,000 tons of ore carrying 2.58 per cent copper.

According to the annual published report of the company owning the Old Dominion mine and smelter at Globe, the smelting ore mined during 1910 averaged 7.85 per cent of copper, as against 6.71 per cent in 1909, and the concentrating ore, 3.49 per cent, against 2.90 per cent in 1909. The ore treated in 1910 yielded 487.78 ounces of gold, 36,743 ounces of silver, and 17,712,755 pounds of copper. Other producers in 1910 were the Arizona-Commercial, Warrior, Keystone, Globe Consolidated, Globe Arizona, Gibson, Copper Hill, Arizona, Colorado, Superior & Boston, and United Globe.

Dripping Springs district.—Production of a small amount of gold and silver from one placer was reported from this district in 1910.

Lost Gulch district.—All of the ore produced from the Bonanza group was treated at a stamp mill, producing gold and silver bullion.

Mazatzal district.—One deep mine and one placer property recorded a production of gold and silver aggregating a value of $256.

Pinto Creek district.—Two operators of deep mines reported the yield of copper ore containing a small amount of gold and silver.

Tonto district.—One producer reported the treatment of 10 tons of ore yielding gold and silver.

GRAHAM COUNTY.

This county was divided in 1910 and the principal mining districts form what is now known as Greenlee County, and under that heading the production of all mines for 1909 and 1910 are compared, with the exception of one mining property, which is situated on the Graham County side of the line.

Aravaipa district.—A shipment of 18 tons of ore to the smelter from one property in the district contained principally lead, with small quantities of gold and silver.

GREENLEE COUNTY.

Mine production of gold, silver, copper and lead, in Greenlee County, Ariz., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,869.24	$38,641	2,331.24	$48,191	+ 462	+$9,550
Silver.....do....	87,733	45,622	147,060	79,413	+ 59,327	+33,791
Copper.....pounds..	71,825,750	9,337,348	72,878,094	9,255,518	+1,052,344	−81,830
Lead.....do....	1,726	873	31,576	1,389	+ 29,850	+ 516
Total.....	.....	9,422,484	.....	9,384,011	.....	−37,973

In 1910 Greenlee County was organized from Graham County, including the principal mining regions with 23 operators of producing mines, the same number reporting for Graham County in 1909. The mines produced 1,561,167 tons of ore, which was only 5,772 tons less than in 1909. The total average value of the ore remained at $6.01 per ton, the same as in 1909, and the gold and silver average value was but a few cents per ton. The larger part of the ore mined, 1,306,783 tons in quantity, was treated at concentration mills, yielding 214,933 tons of

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concentrates, which contained $2,567 in gold, 4,612 ounces of silver, and 52,135,013 pounds of copper, valued in all at $6,626,205, with an average value of $30.82 per ton. There was very little change in the production of concentrating ore from the yield in 1909, when 1,303,963 tons were produced, yielding 200,231 tons of concentrates and averaging $34.34 per ton. Ore mined and shipped directly to smelters, nearly all of which, with the exception of a small quantity of lead ore shipped to a lead plant, was treated in the county, amounted to 253,279 tons, containing $41,664 in gold, 142,397 ounces of silver, 20,743,081 pounds of copper, and 31,576 pounds of lead, aggregating in value $2,754,318, or an average value of $10.87 per ton. The average value of the smelting ore was slightly increased in 1910 over that in 1909, when 262,848 tons were treated, averaging $9.68 per ton. Placer gold bullion reported in 1910 contained $941 in gold and 7 ounces of silver. This was a decided increase over the output in 1909, which was valued at $311, and it is reasonable to expect an increased production for 1911, caused by active operations in the Clifton-Morenci district. The ores produced in the county were nearly all the yield of mines in the Copper Mountain and Greenlee districts, and the output by kinds of ore consisted of 6,393 tons of siliceous ore, containing 1,236.06 ounces of gold, 82,904 ounces of silver, and 319 pounds of copper; copper ores aggregating 1,554,648 tons, containing 996.19 ounces of gold, 63,704 ounces of silver, and 72,876,926 pounds of copper; and lead ores aggregating 126 tons, containing 53.47 ounces of gold, 445 ounces of silver, 849 pounds of copper, and 31,576 pounds of lead.

Copper Mountain and Greenlee districts.—The larger part of the Greenlee County production was the yield of mines situated in these districts. The principal producers were the Detroit, the Arizona-Copper, and the Shannon mines. According to the statement [1] of the management of the Detroit mine, the second largest producer of the district, the quantity of ore treated increased from 472,250 tons in 1909 to 494,286 tons in 1910, but the output of copper decreased from 24,591,021 pounds in 1909 to 23,056,292 pounds in 1910. The decline was due to decreased yield of ore from 2.60 per cent to 2.33 per cent. The ore mined consisted of 474,027 tons of concentrating ore, 7,473 tons of smelting ore, and 11,093 tons of siliceous ore for converter lining. The concentrator operations showed that 473,681 tons of ore, averaging 2.98 per cent copper, were treated, yielding 69,907 tons of concentrate averaging 15.43 per cent of copper. This was a saving of 76.42 per cent of the copper, and 6.78 tons of ore yielded 1 ton of concentrate. Production mined from the Standard mine, a neighboring property, was given as follows:

Classes of ore.	Tonnage.	Pounds of bullion produced.	Percentage copper.	
			Assay of original ore.	Yield in bullion.
Concentrating ore	355.43	14,281	2.889	2.009
Smelting ore	672.12	320,184	26.190	23.819
Siliceous ore for converter lining	899.13	131,844	8.062	7.333
Total and averages	1,926.68	466,309	13.432	12.101

[1] Annual Report 1910, Phelps, Dodge & Co.

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The Arizona Copper Co.'s property in this district was the largest producer of copper in 1910, and according to the published annual report for the fiscal year ending September 30, 1910, the production of Bessemer copper was 32,161,205 pounds, produced from 754,187 tons of ore, or 46.9 tons of ore produced 1 ton of copper. The yield of ore treated in 1910 was 2.13 per cent, or 42.64 pounds of copper per ton. This compares with 2.15 per cent, or 43 pounds per ton for 1909. Of the total ores produced by the mines, 454,513 tons, or 57.6 per cent, came from the Longfellow group, and 334,473 tons, or 42.4 per cent, came from the Metcalf group. Ninety-six per cent of the total ores extracted were concentrating ores, the remaining 4 per cent was first-class smelting ore. Of the total copper produced, 85 per cent came from sulphide ores and 15 per cent from oxide ores. During the year 599,250 dry tons of sulphide concentrating ore were treated, of which 330,621 tons, or 55.2 per cent, were treated at No. 6 concentrator, and 268,629 tons, or 44.8 per cent, were treated at the Clifton concentrator. The average ratio of concentration was 5.14 tons of ore into 1 ton of concentrates. During the fiscal year the oxide concentrator treated 115,223 dry tons of ore, and tailings amounting to 102,831 dry tons were leached. From these ores 11.3 per cent of the total copper production was obtained. The sulphuric-acid plant produced 2,971.50 tons of acid. The acid plant was shut down for a month in the early part of the year, during which time it received a general overhauling—a supply of acid being obtained from the outside meanwhile to keep the leacher going. During the year an average of 3.8 furnaces were in blast, and the total ores and concentrates smelted amounted to 158,532 tons. The average yield of copper from the ore and concentrate was 10.14 per cent.

The third producer of importance was the mine of the Shannon Copper Co., and according to its annual statement for the fiscal year ending August 31, 1910, there were 311,456 tons of ore mined, a daily average of 853 tons, as compared with 307,271 tons, a daily average of 842 tons for the year 1909. During its fiscal year there were 17,600,268 pounds of copper produced from smelter operations. This is about a million pounds more copper from Shannon ores than in the fiscal year 1909, when the total production was 16,565,032 pounds. Copper produced from custom ores aggregated 1,045,236 pounds, which was about half the production of 1909. At the concentrator 111,624 tons of concentrating ore were treated, as against 120,998 tons in 1909.

Other producers were the Buzzard-Shadow, Silver King, Gold Bar, Capote, and Silver Bonanza claims, each yielding ores carrying gold and silver and no copper. Those yielding copper and a little gold and silver were the Cliff, the Copper King, and the San Jose.

Mayflower district.—Shipping ore aggregating 21 tons, containing gold, silver, copper, and lead, represented the output of one mine in this district.

San Francisco River district.—Placer gold was reported from one source.

MARICOPA COUNTY.

Cave Creek district.—In 1910 the output of the district was reported by two deep-mine operators and by buyers of bullion from transitory placer miners. Ore was produced which yielded at the smelters gold, silver, and copper. The larger part of the ore was milled and yielded

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besides bullion a small quantity of concentrate. The total output was valued at $1,488; in 1909 it was $3,011.

Goldfields district.—A revival of one of the old mines in this district was productive of a small shipment of gold and silver bullion from test operations at its milling plant.

San Domingo district.—Mexicans and other small operators produced from placers gold and silver bullion valued at $1,041.

Vulture district.—The Vulture Co.'s old mill was run half the year, and the first unit of the new stamp mill with cyanide plant was in operation in August. The production consisted of 3,015 ounces of gold and 1,082 ounces of silver, valued at $62,906.[1] The output of the district was principally that of the Vulture mine, although two other operators reported production.

MOHAVE COUNTY.

With a production of 99,283 tons of ore by 40 deep-mine operators in 1910, the ore output of Mohave County increased 68,461 tons over that produced by 29 operators in 1909. The total average value per ton of the ore produced decreased from $23.56 in 1909 to $16.12 in 1910, but the gold and silver average value was very little changed, only decreasing from $12.86 to $12.14. The total value of the ore produced in 1910 amounted to $1,601,183, the value representing $1,145,022 in gold, 112,445 ounces of silver, 529,753 pounds of copper, 740,091 pounds of lead, and 5,474,046 pounds of zinc. The output of 1910, when compared with that of 1909, showed an increase in tonnage, and in all metals produced, the gold was greater by $788,659, silver by 32,783 ounces, copper by 216,369 pounds, lead by 626,685 pounds, zinc by 209,925 pounds, the total value increasing $873,517. Of the total tonnage, 90,013 tons consisted of siliceous ores, which yielded 53,751.61 ounces of gold, 39,139 ounces of silver, 1,040 pounds of copper, and 1,780 pounds of lead. Copper ores aggregated 847 tons and contained 26.37 ounces of gold, 6,461 ounces of silver, and 524,757 pounds of copper; lead ores aggregating 790 tons contained 322.72 ounces of gold, 32,618 ounces of silver, 3,956 pounds of copper, and 235,957 pounds of lead; and the zinc ores, which were 7,633 tons in quantity, contained 1,289.74 ounces of gold, 34,227 ounces of silver, 502,354 pounds of lead, and 5,474,046 pounds of zinc (figured as spelter). The larger part of the ore mined, or 89,839 tons, was treated at cyanide and amalgamation mills, yielding bullion containing $1,109,989 in gold and 26,371 ounces of silver. In addition to the bullion, some concentrate, containing gold, silver, copper, and lead, was produced at milling plants equipped for its production. The ores shipped directly to smelters aggregated 9,177 tons, containing $34,301 in gold, 84,709 ounces of silver, 528,727 pounds of copper, 650,385 pounds of lead, and 5,474,046 pounds of zinc, having a total value of $471,407 and an average value of $51.37 per ton. The ore production was divided into 90,013 tons of dry or siliceous ore, 847 tons of copper ore, 790 tons of lead ore, and 7,633 tons of zinc ore. The lead ore was shipped to the smelter at Needles, Cal., and the zinc ore, producing spelter, was shipped to plants in Kansas and Oklahoma. The improvements at the Needles smelter were completed in 1910 and

[1] Statement of gross product for the year 1910 published by the auditor of the Territory, 1911.

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some intermittent runs were made. Ore from surrounding mining camps in Arizona, Nevada, and California, is being contracted for and new sources of supply are being developed, though as yet a sufficient quantity for continuous running is not available. The supply is expected to be materially increased by the operation of the concentrator and of the electrostatic zinc separating plant. The concentrator was completed late in 1910 and part of the material for the electro static plant was ready to be put in place.

Aubrey district.—The production of 7 tons of ore by one operator yielded gold and silver bullion.

Bentley district.—In 1910 the Grand Gulch mine was the only producer in Bentley district and yielded ore of shipping grade which contained copper and silver. The total shipments contained 489,536 pounds of copper and 2,839 ounces of silver, valued in all at $63,875.[1] The property is an old producer and began shipments again about three years ago, sent by the way of Moapa, Nev., to Salt Lake City, Utah.

Gold Basin district.—Three mines yielded 412 tons of ore, principally of milling grade and treated by the cyanide process, except 3 tons of ore containing lead which were sent to smelters.

Hackberry district.—Two operators reported the production of ore, the larger part of which, or 80 tons, was milled, producing gold and silver bullion and concentrate. The remainder of the ore was shipped directly to the smelter. The metals produced were gold, silver, copper, and lead, and aggregated for the total 83 tons produced, a value of $1,634, or an average value of $19.68 per ton.

San Francisco district.—Five mines in 1910 produced 89,284 tons of ore, yielding $1,103,221 in gold and 26,254 ounces of silver, having a total value of $1,117,398, and an average value of $12.52 per ton. The entire product was treated at milling plants equipped with the cyanide process, and bullion and cyanide precipitates containing gold and silver, were produced. The principal producers were the Gold Road and the Tom Reed mines.

Union Pass district.—The Golconda mine was the only producer in the district, yielding zinc ore carrying gold, silver, and a little lead. It is opened by a shaft 335 feet deep. There are several veins yielding ore. One of them has its ore shoot developed for about 800 feet on the two main levels. The ore consists almost entirely of zinc blende and the vein is from 2 to 4 feet wide. From the beginning of operations in February, 1908, the mine has yielded about 17,000 tons of ore averaging about 46 per cent of zinc and small quantities of gold and silver per ton. During the same period, 35,000 tons of milling ore have been mined and were to be treated early in 1911 in the new 35-ton concentration plant under construction in 1910.

Wallapai district.—Ore aggregating 1,109 tons, reported by 25 producers in 1910, yielded $8,773 in gold, 48,509 ounces of silver, 20,341 pounds of copper, and 235,368 pounds of lead, valued in all at $47,908, or an average value of $43.20 per ton. About one-third of the ore was concentrated and the remainder was shipped directly to the smelter with the concentrate. A small quantity of ore was treated at an amalgamation mill, producing gold and silver bullion, and some ore contained zinc, which is being held at the Needles

[1] Statement of the gross product of the year 1910 published by the auditor of the Territory, 1911.

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reduction plant for separation by the electrostatic process. The Needles Mining & Smelting Co. is doing exploration work on several properties in the district. The properties on which work is being done are the Banner mine at Stockton Hill, the Champion mine at Cerbat, and the Tennessee mine at Chloride. The Banner mine is opened to 430 feet, showing no diminution in the strength of the vein and the quality of the ore, of which there is a considerable tonnage. In the Champion mine is developed a moderate tonnage of ore, some of it low grade, but the bulk of commercial value. A surface tramway is now completed for handling the ore. At the Tennessee mine some trouble was experienced with the old shaft. It was expected that this mine would be unwatered and opened up by the last of July, 1910, but the shaft proved to be in such bad condition when the 200-foot level was reached that it was finally decided to sink a new shaft clear of the vein. This shaft is now 500 feet deep. Rich ore bodies, both explored and unexplored, are reported in the property, and it is said to have a record of the largest production of all the mines at Chloride.

Weaver district.—Production of 12 tons of ore, yielding gold, silver, and copper, valued in all at $841, were reported by two operators.

PIMA COUNTY.

Twenty-five deep mines produced in 1910 ore amounting to 177,675 tons, a decrease of 120,948 tons from the output of 1909 and a decrease of 4 in the number of producers. The deep mine production was $2,594 in gold, 109,339 ounces of silver, 6,137,313 pounds of copper, and 289,907 pounds of lead, having a total value of $853,832. The total average value per ton of this ore decreased from $6.26 in 1909 to $4.80 in 1910, and the gold and silver contained in the ore decreased from 37 cents to 34 cents per ton. The output consisted of 31 tons of dry or siliceous ore, 176,722 tons of copper ore, 34 tons of lead ore, and 888 tons of copper-lead ore. The ore treated at smelters, containing chiefly lead and copper, aggregated 172,863 tons, which contained $2,003 in gold, 108,871 ounces of silver, 5,839,528 pounds of copper, and 289,907 pounds of lead, having a total value of $815,169, and an average value of $4.72 per ton. This is a decrease from the output of 1909, when 287,828 tons were treated with an average value of $6.32 per ton. Ore treated at concentration mills aggregated 4,782 tons, yielding 566 tons of concentrate, containing $322 in gold, 465 ounces of silver, and 297,785 pounds of copper, valued in all at $38,392, with an average value of $67.83 per ton. In 1909 there were 678 tons of concentrate produced from 10,791 tons of ore, and the average value per ton of concentrate was $71.18. The milling of 30 tons of ore at 2 amalgamation plants produced a small quantity of gold and silver bullion. The total placer output reported by 4 operators in 1910 was valued at $2,397, of which $2,388 was gold, against an output valued at $2,200 in 1909.

Ajo district.—From reports of 5 producers, 926 tons of ore were mined, which yielded $517 in gold, 421 ounces of silver, and 97,999 pounds of copper, valued in all at $13,190, or an average value of $14.24 per ton. Nearly all of the ore, or 866 tons, was milled, producing concentrate containing copper, and a small quantity of ore

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was treated at an amalgamation mill, producing some gold and silver bullion. There were 50 tons of shipping ore produced.

Arivaca district.—The output of ore, containing some gold, silver, copper, and lead was produced by 2 operators.

Cababi district.—One operator in the district made shipments of ore, containing copper and a little gold.

Greaterville district.—The placers of this district are worked during wet seasons by small operators, and the output of 1910 is partly estimated, aggregating $2,138 in gold and 15 ounces of silver, as against a production valued at $2,209 in 1909.

Helvetia district.—Three operators of deep mines reported in 1910 the production of 124 tons of ore, containing copper and lead and some gold and silver. The Helvetia copper mines were doing a large amount of development work in 1910 and made trial shipments of copper ore to the smelters.

Pima district.—The yield of 3,296 tons of ore was reported from 7 deep mines in 1910. All of the ore was shipped to the smelters, yielding $1,777 in gold, 27,098 ounces of silver, 303,522 pounds of copper, and 278,746 pounds of lead, aggregating in value $67,222, an average value of $20.40 per ton. The Morgan mine of the Twin Buttes group yielded sulphide and oxidized copper ores of shipping grade, which were sent to El Paso, Tex. Copper-lead ore with silver and a little gold was produced from the Esperanza property.

Quijotoa district.—Placer bullion from dry washing operations in Quijotoa district was estimated at $250 in gold and 1 ounce of silver. During 1910 a Quenner pulverizer of the same type as that successfully operated at Sonora, Mexico, was introduced to work the placer beds in this district.

Saltwell district.—One deep-mine operator reported the production of gold and silver ore, which was treated at a milling plant.

Silver Bell district.—With 4 operators of deep mines producing in 1910, the output of the district aggregated 173,267 tons of ore, which yielded $41 in gold, 79,412 ounces of silver, and 5,724,858 pounds of copper, valued in all at $769,980, or an average value of $4.44 per ton. The larger part of the ore was smelted and 3,916 tons were concentrated, yielding a product containing copper and silver. In August, 1910, the Sasco smelter of the Imperial mines was closed to await further development of the mine, on which considerable churn drilling and underground mining was being performed. The smelter depends upon a cheaper transportation for its output and supplies.

PINAL COUNTY.

The ore produced by 15 deep-mine operators in Pinal County in 1910 aggregated 239 tons, a decrease of 36,405 tons from the production of 1909, which was reported by the same number of operators. The metal production was $1,999 in gold, 9,956 ounces of silver, 11,361 pounds of copper, and 13,081 pounds of lead, with a total value of $9,394. As a result of the decreased tonnage of ore, the average value per ton increased from $4.12 in 1909 to $39.30 in 1910, as the ore was of sorted grade rather than run of mine grade. The average gold and silver value of this ore increased from $1.72 in 1909 to $30.85 in 1910. The output of smelting ore, aggregating 93 tons,

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contained $461 in gold, 9,936 ounces of silver, 11,361 pounds of copper, and 13,081 pounds of lead, in all valued at $7,845, or an average value of $84.35 per ton. The largest part of the ore produced in the county was treated at 3 milling plants, yielding gold and silver bullion. No concentrate was shipped in 1910, and the production in 1909 consisted largely of the output from experimental work at the Ray mines. The shipments in 1911 will aggregate many tons of concentrate, and the production from that source will be important. No placer production was reported in 1910.

Bunker Hill district.—The output of one property in this district, yielding copper and silver, was shipped to the smelter. A new concentration mill was put in operation early in 1910 to treat the ores of the American Eagle, Sycamore, Flat, Bellevue, and Cumberland groups, comprising over 100 mining claims. The first unit of the 1,000-ton concentrator has a capacity of 250 tons of ore. No production was reported from the properties.

Casa Grande district.—A small trial shipment of ore was made from one of the properties in the district and contained small quantities of silver, lead, and copper.

Mineral Creek district.—Only 13 tons of copper ore, containing considerable gold, were shipped from the district in 1910. Preparations for shipments were made by the large companies, and some shipments were made that were held in storage bins at the new concentrator of the Ray Consolidated Copper Co., at Hayden. According to the annual report of the company, developments at the Ray mine demonstrated something over 59,000,000 tons of assured ore, and the acquisition of practically all the outstanding stock of the Gila Copper Co. adds about 16,000,000 tons, or gives a total of more than 75,000,000 tons, containing an average copper content of 2.17 per cent. The 5,000-ton concentrating mill now being constructed will commence operating a substantial part of its capacity early in 1911, and the smelter is expected to be in operation a few months later. At the present time a force of about 730 men is employed at the mine and 470 men at the mill, smelter, and power plant. The mill and smelter are situated at Hayden, a point on the Arizona Eastern Railroad about 15 miles southeast from Kelvin and about 21 miles from the mines.

Mineral Hill district.—One deep-mine operator shipped a small tonnage of siliceous ore.

Old Hat district.—Three operators of deep-mines reported a production of 146 tons of ore, yielding $1,539 in gold and 20 ounces of silver. This was a marked decrease from the yield of 1909, when 10,521 tons of ore were produced, valued at $53,003.

Pioneer district.—Seven small operators reported the production of 35 tons of ore, containing $88 in gold, 5,980 ounces of silver, 3,065 pounds of copper, and 13,051 pounds of lead, valued at $4,281, or an average value of $122.31 per ton. All of the ore was shipped directly to the smelter.

Silver King district.—One operator reported the production of a small quantity of ore, containing principally silver, with some copper and gold.

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SANTA CRUZ COUNTY.

In 1910 the quantity of ore mined in Santa Cruz County aggregated 793 tons, reported by 21 deep-mine operators. This was 1,164 tons less than the production of 1909, which was reported by 10 operators. The metal production in 1910 was $2,658 in gold, 83,219 ounces of silver, 42,261 pounds of copper, 107,500 pounds of lead, and 10,853 pounds of zinc, valued at $58,279. The ore, aside from placer product, had an average value of $72.39 per ton, which was an increase from $13.27 per ton in 1909 for the reason that the ores are largely sorted. The gold and silver value in this ore increased from $3.31 per ton in 1909 to $58.92 per ton in 1910. The largest part of the production, or 702 tons, was shipped directly to smelters and yielded $886 in gold, 82,981 ounces of silver, 42,179 pounds of copper, 104,380 pounds of lead, and 10,853 pounds of zinc, with a total value of $56,232 and an average value of $80.10 per ton. In 1909 the yield of ore shipped directly to smelters had a total value of $23,687 and an average value of $13.09 per ton. From 50 tons of ore treated at amalgamation mills, bullion containing $899 in gold and 17 ounces of silver was secured. The total placer yield in 1910 was $871 in gold and silver, of which $865 was gold, as against $92 in gold and silver in 1909.

Harshaw district.—The production of the district, reported by 4 deep-mine operators, aggregated 460 tons of ore, containing $457 in gold, 78,414 ounces of silver, 12,348 pounds of copper, and 54,539 pounds of lead, valued in all at $46,769, an average value of $101.67 per ton.

Nogales district.—One operator reported the production of lead ore, containing silver and a little copper.

Oro Blanco district.—In 1910 two operators produced 57 tons of ore, $1,780 in gold, 203 ounces of silver, 804 pounds of lead, and a little copper, in all valued at $1,925, including the production of 1 placer. Of the total ore produced, 50 tons were treated at amalgamation mills, producing gold and silver bullion.

Patagonia district.—The output of this district, reported by 10 operators in 1910, aggregated 213 tons of ore, containing $408 in gold, 2,795 ounces of silver, 27,737 pounds of copper, 32,127 pounds of lead, and 10,853 pounds of zinc, in all valued at $7,440, or an average value of $34.93 per ton. All of the ore produced was of shipping grade; that containing lead was shipped to San Francisco, Cal., and to El Paso, Tex., and the zinc ore to an eastern plant. A small quantity of old matte, containing lead and a little copper, was recovered from one of the old smelter slag dumps.

Tyndall district.—Operators of 3 deep mines reported a production of 15 tons of ore, which was shipped to the smelter, and contained gold, silver, copper, and lead.

Wrightson district.—One property was operated in 1910, as against 2 in 1909. The output, which was only 23 tons, was crude ore shipped directly to the smelter and yielding silver and copper.

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YAVAPAI COUNTY.

Mine production of gold, silver, copper, and lead in Yavapai County, Ariz., in 1909 and 1910.

Metals.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	46,064.76	$952,243	42,665.30	$881,970	− 3,399.46	−$70,273
Silver.....do....	578,580	300,862	699,702	377,839	+ 121,122	+ 76,977
Copper.....pounds..	37,125,964	4,826,375	40,824,556	5,184,719	+3,698,592	+358,344
Lead.....do....	409,890	17,625	264,911	11,656	− 144,979	− 5,969
Total.....	.....	6,097,105	.....	6,456,184	.....	+359,079

The production of Yavapai County in 1910 by 87 operators was 417,308 tons of ore. This is an increase of 93,819 tons of ore, and there were 48 operators in 1909. The total average value per ton decreased from $18.80 in 1909 to $15.44 in 1910, and the average value of the gold and silver contained in the ore decreased from $3.83 to $2.99 per ton. The ore treated at smelters aggregated 362,936 tons, containing $484,892 in gold, 652,772 ounces of silver, 40,785,359 pounds of copper, and 71,659 pounds of lead, with a total value of $6,020,283 and an average value of $16.58 per ton. There were also 3,205 tons of old tailing, containing gold, silver, and copper, used for converter lining at one of the smelters. In 1909 the tonnage of smelting ore was 275,918 tons, which had an average value of $20.39 per ton At Humboldt the Consolidated Arizona smelter, after an idleness of two years, resumed the treatment of copper ore from its Blue Bell property and its Coconino County mines, and also treated a large tonnage of custom ore. The smelter has been thoroughly remodeled and about 75,000 tons of ore are stored in the yards. The United Verde smelter, at Jerome, treated the largest tonnage of copper ore, which was entirely from its own properties. Some of the ore, valuable as flux, was shipped to the Humboldt smelter. The ore containing lead produced in the county was shipped to Needles, Cal., and to El Paso, Tex. Some high-grade gold concentrate produced in the county was shipped to the smelter at Vallejo, Cal. At amalgamation and cyanide mills 43,217 tons of ore were treated, yielding gold bullion and precipitates, which contained $184,379 in gold and 6,022 ounces of silver. Concentrates were produced at many of the mills equipped for amalgamation, and in addition to the bullion yield 7,950 tons of ore produced 2,074 tons of concentrate, which contained $190,395 in gold, 33,935 ounces of silver, 35,108 pounds of copper, and 193,252 pounds of lead, valued in all at $221,682, or an average value of $106.88 per ton of concentrate. In 1909 concentrate aggregating 4,084 tons was produced from amalgamation and concentration mills, with an average value of $62.97 per ton for the gold, silver, copper, and lead. Siliceous ores produced in the county aggregated 51,644 tons and yielded 16,921.09 ounces of gold, 74,255 ounces of silver, 26,623 pounds of copper, and 101,105 pounds of lead. Copper ores aggregated 363,338 tons, containing 24,628.07 ounces of gold, 614,829 ounces of silver, and 40,784,853 pounds of copper. Lead

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ores aggregated 2,224 tons, containing 518.02 ounces of gold, 8,576 ounces of silver, 2,805 pounds of copper, and 140,659 pounds of lead. Copper-lead ores aggregated 102 tons, containing 38.81 ounces of gold, 1,986 ounces of silver, 10,275 pounds of copper, and 23,147 pounds of lead. Placer operators were active in the construction of dredging plants in 1910, during which time no production was made. There was a decrease in the placer output, since the total amounted to $11,562 in gold and 62 ounces of silver, as against a yield of $15,599 for gold and silver in 1909. In 1908 the placer output was valued at $13,708.

Big Bug district.—Mines in the Big Bug district in 1910 produced 37,837 tons of ore, containing $104,580 in gold, 58,296 ounces of silver, 2,069,919 pounds of copper, and 119,611 pounds of lead, valued in all at $404,203. This output was made by 20 deep mines. From the placers $2,116 in gold and 9 ounces of silver were produced from six different sources. In 1909 the total output was 17,888 tons, and the total value of the ore and placer output was $378,148. At milling plants using amalgamation and concentration processes 5,073 tons of ore were treated, yielding $25,181 in gold, 389 ounces of silver, and 322 tons of concentrates, containing 687.79 ounces of gold, 2,733 ounces of silver, 2,236 pounds of copper, and 89,856 pounds of lead. The smelting ore aggregated 29,545 tons, containing 2,633.69 ounces of gold, 48,257 ounces of silver, 2,063,594 pounds of copper, and 29,755 pounds of lead. There were also 3,205 tons of old tailing smelted containing gold, silver, and copper, which was valuable as converter lining. The producers were the Poland, Lelan, Monroe, Dividend and Ticonderoga, Poland Extension, Blue Bell, McCabe and Gladstone, and Little Jessie mines.

Black Rock district.—With the production of 465 tons of smelting and milling ore produced by 7 operators in 1910, the district output was valued at $5,185 for the content of $2,485 in gold, 633 ounces of silver, and 18,572 pounds of copper. The ore shipped directly to smelters aggregated 173 tons, containing 32.79 ounces of gold, 615 ounces of silver, and all of the copper. The remainder of the ore was treated at an amalgamation mill, producing gold and silver bullion.

Cherry Creek district.—Six operators of deep mines reported the production of 1,332 tons of ore, containing $6,352 in gold, 93 ounces of silver, and 394 pounds of copper, having a total value of $6,452 and an average value of $4.84 per ton. Nearly all of the ore, with the exception of 5 tons, which were shipped to a smelter, was treated in amalgamation and concentration mills, yielding bullion and concentrates. In 1909 the total value of the district output was $7,772.

Eureka district.—The production of ore mined by 2 operators aggregated 77 tons, containing $1,291 in gold, 869 ounces of silver, 11 pounds of copper, and 2,349 pounds of lead, valued at $1,864, or an average value of $24.21 per ton.

Granite district.—A small tonnage of shipping ore was sent to the smelter, containing gold, copper, and a little silver.

Hassayampa district.—In 1910 13 operators of deep mines produced 1,341 tons of ore, containing $8,718 in gold, 1,593 ounces of silver, 392 pounds of copper, and 14,723 pounds of lead, valued in all at $10,276, an average value of $7.66 per ton. The larger part

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of the ore, or 1,301 tons, was treated at milling plants, producing gold and silver bullion and concentrate. Forty tons of ore, containing gold, silver, and lead, were shipped directly to smelters.

Humbug district.—Two deep mines and 2 placer operators reported a product valued at $1,270. The ore produced, most of which was of shipping grade, yielded from 24 tons at the smelter 2.95 ounces of gold, 25 ounces of silver, and 5,783 pounds of copper.

Kirkland district.—One deep mine reported a small production of ore during the year, which was shipped to the smelter and contained gold and silver.

Martinez district.—All of the ore mined in the district in 1910 was milled. It aggregated 28,335 tons, produced from 3 mines. The principal producers were the Congress mine and the United Gold Mines Co. A large part of the production was the yield of the Congress mine, which produced 7,969 ounces of gold, 17,162 ounces of silver, and 10,008 pounds of copper, having a total value of $175,220.[1]

Peck district.—A small lot of copper ore, containing some gold and silver, was the yield of one mine in 1910.

Pine Grove district.—One operator reported the production of ore, containing a large quantity of silver, some copper and lead, and a small quantity of gold.

Silver Mountain district.—A shipment of 25 tons of crude ore and the treatment of 15 tons at a milling plant in the district yielded $1,795 in gold, 267 ounces of silver, and 4,994 pounds of copper.

Thumb Butte district.—Smelting ore amounting to 4 tons was shipped from the district, which contained gold, silver, and copper.

Tiger district.—The yield of ore by 5 operators in 1910 aggregated 3,735 tons, which contained $63,424 in gold, 8,405 ounces of silver, 15,318 pounds of copper, and 11,808 pounds of lead, valued in all at $70,428, an average value of $18.86 per ton. From the ore treated at milling plants, gold and silver bullion and concentrates, containing gold, silver, and copper, were shipped. The smelting ore, 40 tons in quantity, contained lead with considerable gold and a little silver.

Turkey Creek district.—The operators of 1 placer and 1 deep mine reported in 1910 a total yield of $237, a marked decrease from the production reported in 1909 of $3,136, which was principally for ore treated at amalgamation and concentration mills.

Verde district.—Two operators reported production. The principal property in the district, the United Verde mine, equipped with a smelter, produced 38,663,880 pounds of copper, 19,267 ounces of gold, and 398,247 ounces of silver, valued at $5,624,449.[1] In 1909 the total value of the product was $5,370,766.

Walker district.—Thirteen deep-mine operators in 1910 reported the production of 9,295 tons of ore, containing $58,216 in gold, 7,823 ounces of silver, 8,325 pounds of copper, and 94,477 pounds of lead, valued in all at $67,656, an average value of $7.28 per ton. The product of gold and silver from placers from 4 mines aggregated $2,074. Mills equipped for concentration and amalgamation treated 1,257 tons of ore, yielding bullion which contained $8,145 in gold, 210 ounces of silver, and concentrate. Concentrates produced at the milling plants aggregated 758 tons and yielded 2,223.37

[1] Statement of gross product for the year 1910, published by the auditor of the Territory, 1911.

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ounces of gold, 5,927 ounces of silver, 5,739 pounds of copper, and 82,218 pounds of lead.

Walnut Grove district.—One placer operator reported a small production of gold and silver.

Weaver district.—Four deep mines yielded 1,842 tons of ore in 1910, all of which, with the exception of 1 ton, was treated at amalgamation and concentration mills, producing gold and silver bullion and concentrate containing lead and copper. The total value of the ore produced in the district was $20,455, and the placer production was valued at $5,993. In 1909 the placer production was $6,980 in gold. The output was made by small operators of placers in the gulches of Rich Hill during the rainy season.

YUMA COUNTY.

The quantity of ore mined in Yuma County by 28 deep-mine operators aggregated 38,240 tons in 1910, which was a decrease of 61,564 tons from that produced in 1909, when 24 operators reported production. The total average value per ton increased from $8.05 in 1909 to $11.39 in 1910, and the average value of the gold and silver in this ore increased from $7.28 to $10.15. The decrease in tonnage is largely attributed to the closing of the King of Arizona mine. The tonnage of crude ore shipped to smelters increased from 1,131 tons in 1909 to 6,461 tons in 1910. The metal yield was $11,694 in gold, 11,051 ounces of silver, 359,430 pounds of copper, and 46,555 pounds of lead, with a total value of $65,359, at an average value of $10.12 per ton. In 1909 the average value of the shipping ore was $36.15 per ton. The lower average value per ton of smelting ore treated in 1910 is attributed to the increased tonnage treated at local plants, one of which was situated at Swansea, and to the transportation rate which allowed the shipment of low-grade ores to Humboldt, in Yavapai County. The treatment of 31,779 tons of ore at cyanide and amalgamation plants resulted in a production of $365,755 in gold and 7,798 ounces of silver, as against 98,673 tons treated in 1909, yielding $755,468 in gold and 13,140 ounces of silver. There was also produced a small quantity of concentrate at one of the plants. A recent description of the mining properties and ore deposits in northern Yuma County is given by Howland Bancroft in Bulletin 451 of the United States Geological Survey.

Castle Dome district.—The total production of the district aggregated $3,507 in gold, 965 ounces of silver, and 46,555 pounds of lead, which was the yield of 3 deep mines and 3 placers, mainly from dry diggings.

Cienega district.—Five operators of deep mines and 1 placer operator reported the production of $4,410 in gold, 36 ounces of silver, and 16,596 pounds of copper, with a total value of $6,537.

Ellsworth district.—A production of 143 tons of ore was made by 7 deep mine-operators, which contained $2,151 in gold, 299 ounces of silver, and 20,952 pounds of copper, valued in all at $4,973, an average value of $34.77 per ton.

Hydra district.—The Glorioso property, 20 miles north of Wenden, was equipped with a small mill in 1910, to treat an oxidized copper ore containing a little gold.

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Kofa district.—Deep-mine operators reported the production of gold and silver recovered at cyanide mills. The King of Arizona closed its milling plant early in the year. The principal producer was the Golden Star mine, which yielded 15,945 ounces of gold and 7,492 ounces of silver, valued at $333,590.[1] The dry-placer diggings, according to reports from three sources, yielded $655 in gold and 8 ounces of silver.

Laguna district.—The placer production from 2 operators aggregated $1,454 in gold and 5 ounces of silver.

La Posa district.—From dry-placer operations, $294 in gold and 5 ounces of silver were reported. No ore was shipped during 1910.

Planet district.—During part of 1910 the Clara Consolidated copper smelter at Swansea was operated on its own ores and on ores purchased for fluxing purposes. The operation of the 750-ton water-jacketed blast furnace and converters was largely experimental. The mine is developed by 6 shafts, which are from 200 to 500 feet deep.

Plomosa district.—Ten operators of deep mines reported the production of 588 tons of ore, containing $6,950 in gold, 4,259 ounces of silver, 41,849 pounds of copper, and 35 pounds of lead, valued at $14,572, an average value of $24.78 per ton. The placer production came principally from the dry diggings and contained $2,368 in gold and 28 ounces of silver. A Lane slow-speed mill was worked on the Fred Stafford property, 5 miles from Vicksburg, and is said to have saved on the plates about $12 in gold per ton of ore treated.

CALIFORNIA.

By CHARLES G. YALE.

PRODUCTION.

For the calendar year 1910 the California production of gold, silver, copper, and lead was valued at $27,020,405, a decrease of $1,820,645 as compared with $28,841,050 in 1909. This decrease was mainly due to the lessened output of copper, although there was a material decrease in gold yield as well as some falling off in silver product. Lead production only showed an increase in 1910. The decrease in gold was 25,272.55 fine ounces, valued at $522,430; in silver, 258,168 fine ounces in quantity and $97,446 in value; and in copper, 8,587,525 pounds in quantity and $1,262,480 in value. The lead output increased 1,368,380 pounds in quantity and $61,711 in value. There was no yield of zinc reported in the State in 1910.

There were 1,079 producing properties, of which 515 were deep, and 564 placers. There were 48 less producing mines in 1910 than in 1909. The deep mines may be classified by metal produced as follows: Gold, 485; silver, 9; silver-lead, 10; and copper, 11. Of the placer mines 168 are hydraulic, 72 dredge, 139 drift, and 185 surface or sluicing properties. The dredges are enumerated by the number of boats at work and were operated by 41 companies. There were 34 more hydraulic mines producing in 1910 than in 1909, and 9 more dredges, as well as 21 more drift mines, but there were 56 less surface or sluicing mines. There were 56 less deep mines producing in 1910 than in 1909, but there were 8 more placers.

[1] Statement of gross product for the year 1910, published by the auditor of the Territory, 1911.

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The 515 deep mines producing in the State in 1910 made an output of 2,697,885 tons of ore, 343,803 tons less than were produced in 1909. Of this output 1,963,296 tons were siliceous ore, 716,685 tons copper ore, and 17,904 tons lead ore. The siliceous-ore output decreased by 232,445 tons in 1910, and the copper ore by 123,673 tons, while the lead ore increased by 12,315 tons.

The siliceous ore yielded an average of $5.23 per ton in gold and silver, the copper ore $1.94, and the lead ore $6.71. The average in gold and silver from all the ores treated in the State in 1910 was $4.37 per ton.

The 2,697,885 tons of ore of all classes treated in the State in 1910 yielded 523,738.95 fine ounces of gold, valued at $10,826,645; 1,798,229 fine ounces of silver, valued at $971,044; 48,700,756 pounds of copper, valued at $6,184,996; and 2,870,977 pounds of lead, valued at $126,323.

The total value of the metals obtained from the ore mined and treated in California in 1910 was $18,109,008, a total average value per ton of $6.71. In 1909 the output was 3,041,688 tons, valued at $19,715,314, a total average value per ton of $6.48; and in 1908 the output was 2,546,908 tons, valued at $16,536,226, an average value per ton of $6.49.

In 1910 there were treated at gold and silver mills 1,900,556 tons of ore, and at concentrating mills 3,497 tons, containing altogether $9,906,503 in gold, an average of $5.20 per ton, and $98,687 in silver, an average value of 5 cents per ton. This was a total value of $10,005,190 in gold and silver and an average value per ton of $5.25 in both metals. The average value per ton in 1909 was $4.88 and in 1908 it was $5.08.

Of the total value, $7,926,017 in gold, averaging $4.17 per ton, and $78,817 in silver, averaging 4 cents per ton, a total of $8,004,834 in gold and silver, averaging $4.21 per ton in both metals, was recovered as bullion in the mills.

From 1,900,556 tons of gold milling ore and 3,497 tons of ore shipped to concentrating mills 33,699 tons of concentrates were obtained, valued at $1,980,486 in gold, an average of $58.77 per ton, and at $19,870 in silver, an average of 56 cents per ton. This is a total yield in gold and silver valued at $2,000,356, or an average value recovered from the concentrates of $59.33 per ton in gold and silver.

Of smelting ores (mainly copper ores) there were 741,884 tons, valued at $802,511 in gold, an average of $1.08 per ton, and at $866,497 in silver, an average of $1.16 per ton. The total yield of gold and silver in the smelting ores was $1,669,008, or an average value of $2.24 per ton in gold and silver.

There were also 51,948 tons of old tailings treated, producing $117,631 in gold, an average of $2.26 per ton, and $5,860 in silver, an average of 11 cents per ton. The total gold and silver in the tailings was valued at $123,491, an average of $2.37 per ton.

The 564 productive placer mines in California in 1910 yielded 429,995.46 fine ounces of gold, valued at $8,888,795, and 41,856 fine ounces of silver, valued at $22,602, a total value in gold and silver of $8,911,397. This was a decrease of $214,339 from the value of the placer output in gold and silver of 1909. The gold decrease was $215,638, while the placer silver output showed an increase in value of $1,299. In gold production the dredge properties of California

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showed an increase of $167,304 in 1910, and the hydraulic mines an increase of $29,890. In the same period the drift mines showed a decrease of $222,868, and the surface placer or sluicing mines a decrease of $189,964.

The statement of production in California for 1909 and 1910, showing increase or decrease and value at each year's commercial prices, is as follows:

Mine production of gold, silver, copper, and lead in California in 1909 and 1910.

Metal.	1909		1910		Increase (+), decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	979,006.96	$20,237,870	953,734.41	$19,715,440	−25,272.55	− 522,430
Silver.....do....	2,098,253	1,091,092	1,840,085	993,646	− 258,168	− 97,446
Copper.....pounds..	57,288,281	7,447,476	48,700,756	6,184,996	−8,587,525	−1,262,480
Lead.....do....	1,502.597	64,612	2,870.977	126,323	+1,368,380	+ 61,711
Total.....	.....	28,841,050	.....	27,020,405	.....	−1,820,645

The following table shows the production of gold, silver, copper, and lead in California in 1910, by counties:

Production of precious metals, by source and counties, and production of copper and lead, by counties, in California in 1910.

County.	Ore treated.	Deep-mine gold.		Placer gold.		Total gold.		Deep-mine silver.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	*Fine ozs.*		*Fine ozs.*		*Fine ozs.*		*Fine ozs.*	
Amador.....	577,934	126,614.94	$2,617,363	1,397.22	$28,883	128,012.16	$2,646,246	36,594	$19,761
Butte.....	13,578	932.96	19,286	119,413.93	2,468,505	120,346.89	2,487,791	770	416
Calaveras.....	436,263	43,745.46	904,299	11,774.77	243,406	55,520.23	1,147,705	153,309	82,787
Colusa and Lassen.....	12,102	3,975.46	82,180	.....	.....	3,975.46	82,180	1,800	972
Del Norte.....	.....	.....	.....	115.52	2,388	115.52	2,388	.....	.....
Eldorado.....	17,383	5,502.22	113,741	2,784.61	57,563	8,286.83	171,304	1,389	750
Fresno.....	14,482	145.51	3,008	17.66	365	163.17	3,373	5,711	3,084
Humboldt.....	10	4.98	103	1,702.12	35,186	1,707.10	35,289	2	1
Imperial and San Diego.....	44,835	4,225.12	87,341	.....	.....	4,225.12	87,341	439	237
Inyo.....	52,963	19,761.62	408,509	.....	.....	19,761.62	408,509	239,982	129,590
Kern.....	197,550	29,821.59	616,467	169.65	3,507	29,991.24	619,974	64,830	35,008
Madera.....	2,369	487.43	10,076	.....	.....	487.43	10,076	3,426	1,850
Mariposa.....	42,703	15,189.27	313,990	173.67	3,590	15,362.94	317,580	4,355	2,352
Merced and Stanislaus.....	.....	.....	.....	10,361.30	214,187	10,361.30	214,187	.....	.....
Modoc.....	774	263.06	5,438	.....	.....	263.06	5,438	139	75
Mono.....	24,913	21,078.15	435,724	.....	.....	21,078.15	435,724	17,391	9,391
Monterey, San Luis Obispo, and Santa Cruz	410	36.91	763	12.09	250	49.00	1,013	19	10
Nevada.....	250,358	114,497.14	2,366,866	8,060.10	166,617	122,557.24	2,533,483	29,183	15,759
Placer.....	15,688	4,053.78	83,799	8,387.84	173,392	12,441.62	257,191	1,206	651
Plumas.....	41,681	6,788.14	140,323	2,268.01	46,884	9,056.15	187,207	1,615	872
Riverside.....	557	270.17	5,585	.....	.....	270.17	5,585	52	28
Sacramento.....	150	113.05	2,337	67,460.73	1,394,537	67,573.78	1,396,874	65	35
San Bernardino..	7,102	2,566.73	53,059	98.39	2,034	2,665.12	55,093	18,802	10,153
Shasta.....	696,333	70,917.02	1,465,985	3,277.07	67,743	74,194.09	1,533,728	1,201,272	648,687
Sierra.....	28,461	11,269.68	232,965	3,825.01	79,070	15,094.69	312,035	2,065	1,115
Siskiyou.....	13,331	6,053.26	125,132	15,104.80	312,244	21,158.06	437,376	1,588	858
Trinity.....	7,925	6,132.40	126,768	18,096.26	374,083	24,228.66	500,851	1,592	860
Tuolumne.....	197,737	29,083.87	601,217	697.03	14,409	29,780.90	615,626	10,609	5,729
Yuba.....	293	209.03	4,321	154,797.68	3,199,952	155,006.71	3,204,273	24	13
Total.....	2,697,885	523,738.95	10,826,645	429,995.46	8,888,795	953,734.41	19,715,440	1,798,229	971,044

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Production of precious metals, by source and counties, and production of copper and lead, by counties, in California in 1910—Continued.

County.	Placer silver.		Total silver.		Copper.		Lead.		Grand total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
Amador	289	$156	36,883	$19,917	151,480	$19,238			$2,685,401
Butte	11,081	5,984	11,851	6,400			659	$29	2,494,220
Calaveras	1,939	1,047	155,248	83,834	7,302,331	927,396			2,158,935
Colusa and Lassen			1,800	972					83,152
Del Norte	22	12	22	12					2,400
Eldorado	402	217	1,791	967					172,271
Fresno	6	3	5,717	3,087	486,724	61,814			68,274
Humboldt	276	149	278	150					35,439
Imperial and San Diego			439	237					87,578
Inyo			239,982	129,590	58,047	7,372	2,866,894	126,143	671,614
Kern	61	33	64,891	35,041			569	25	655,040
Madera			3,426	1,850	298,898	37,960			49,886
Mariposa	22	12	4,377	2,364					319,944
Merced and Stanislaus	1,119	604	1,119	604					214,791
Modoc			139	75					5,513
Mono			17,391	9,391					445,115
Monterey, San Luis Obispo, and Santa Cruz	6	3	25	13					1,026
Nevada	1,383	747	30,566	16,506					2,549,989
Placer	937	506	2,143	1,157					258,348
Plumas	308	166	1 923	1,038			1,114	49	188,294
Riverside			52	28					5,613
Sacramento	8,465	4,571	8,530	4,606					1,401,490
San Bernardino	20	11	18,822	10,164	5.992	761	1,545	68	66,086
Shasta	404	218	1,201,676	648,905	40,397,284	5,130,455	196	9	7,313,097
Sierra	398	215	2,463	1,330					313,365
Siskiyou	2,711	1,464	4,299	2,322					439,698
Trinity	2,037	1,100	3,629	1,960					502,811
Tuolumne	46	25	10,655	5,754					621,390
Yuba	9,924	5,359	9,948	5,372					3,209,645
Total	41,856	22,602	1,840,085	993,646	48,700,756	6,184,996	2,870,977	126,323	27,020,405

GOLD.

The total gold production in California in 1910 was 953,734.41 fine ounces, valued at $19,715,440, as compared with 979,006.96 fine ounces, valued at $20,237,870, in 1909. The decrease for 1910 was therefore 25,272.55 fine ounces, valued at $522,430. The deep mines of the State yielded 523,738.95 fine ounces of gold, valued at $10,826,645. Of this deep-mine gold 490,705.36 fine ounces, valued at $10,143,780, was derived from siliceous ore; 31,844.68 fine ounces, valued at $658,288, was from copper ore; and 1,188.91 fine ounces, valued at $24,577, was from lead ore.

The total placer yield in 1910 was 429,995.46 fine ounces, valued at $8,888,795. Of this, $635,498 was derived from 168 hydraulic mines, $516,929 from 139 drift mines, $7,550,254 from 72 dredges, and $186,114 from 185 surface or sluicing mines, the dredges producing $6,211,713 more gold in 1910 than all the hydraulic, drift, and surface placers combined. The deep mines of California produced $1.937,850 more gold than the combined placers in 1910. The placers produced 45.09 per cent of the entire gold yield in 1910 and the deep mines 54.91 per cent, the proportion being virtually the same as in 1909.

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The dredges in the State produced 38.30 per cent of the total gold yield from all sources in 1910. Of total placer gold the dredges produced 84.94 per cent; the hydraulic mines, 7.15 per cent; the drift mines, 5.82 per cent; and the surface or sluicing mines, 2.09 per cent. The dredge-mining record in gold for the last 11 years is shown as follows, with the increase or decrease for each year:

Value of gold won by dredging in California, 1899–1910, with increase (+) or decrease (−), by years.

Year.	Value.	Increas (+) or decrease (−).
1899	$206,302	.....
1900	200,929	− $5,373
1901	471,762	+ 270,833
1902	867,665	+ 395,903
1903	1,475,749	+ 608,084
1904	2,187,038	+ 711,289
1905	3,276,141	+1,089,103
1906	5,098,359	+1,822,218
1907	5,065,437	− 32,922
1908	6,536,189	+1,470,752
1909	7,382,950	+ 846,761
1910	7,550,254	+ 167,304
Total	40,318,775	.....

In the three great dredging fields of the State (not including outside districts, where only one or more dredges are in operation), the Yuba County field increased its annual output of gold in 1910 by $730,557, the Sacramento County field decreased by $164,542, and the Butte County field decreased its output by $501,038. In Yuba County in 1910 there were 15 dredges operating, the same number as in 1909; in Sacramento County there were 8 dredges, the same as in 1909; and in Butte County there were 32 dredges as compared with 30 in 1909. In the whole State there were 72 dredges operating in 1910 as compared with 63 in 1909, an increase of 9 for 1910. Many of the new dredges in isolated districts are of small capacity compared with those in use in the larger fields.

Of the 34 counties producing gold in 1910 in California, 9 yielded no placer gold, and 4 yielded no gold from deep mines. Seven counties yielded over $1,000,000 each in gold in 1910, as follows: Yuba, $3,204,273; Amador, $2,646,246; Nevada, $2,533,483; Butte, $2,487,791; Shasta, $1,533,728; Sacramento, $1,396,874; Calaveras, $1,147,705. Of these, Butte, Sacramento, and Yuba are dredge-mining counties, and the others are essentially deep-mining counties. In gold production from deep mines, Amador County led with an output of $2,617,363, followed by Nevada with $2,366,866, Shasta with $1,465,985, and Calaveras with $904,299.

The largest production of gold in California in 1910 came from Yuba County, which thus takes the lead from Butte. The most productive county in gold from deep mines was Amador, which displaces Nevada from the lead it has held for many years. The leading hydraulic-mining county, as shown by the returns, was Trinity; the greatest gold-producer from drift mines was Placer; the largest producer from dredge mines was Yuba; and the largest producer of gold from surface

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or sluicing mines was Plumas. The county which showed the largest increase of gold yield in 1910, as compared with 1909, was Yuba with an increase of $734,408, followed by Amador with $347,461, Sierra with $122,363, and Mono with $80,815. Some counties showed material decreases in gold output for the year, notably Butte $499,288, Tuolumne $310,077, Calaveras $292,806, Sacramento $272,940, and Nevada $126,752. The combined decrease by those counties showing a lessened gold output was $1,904,711, while the combined increase in the other counties was $1,382,281, a total net decrease of gold yield in California for 1910 of $522,430.

The production of gold from placers and from different kinds of ore in California in 1910 by counties, in fine ounces, is given in the following table:

Source of gold production in California by kinds of ore in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.				Grand Total.
		Siliceous ore.	Copper ores.	Lead ores.	Total.	
Amador	1,397.22	126,134.00	480.94	.....	126,614.94	128,012.16
Butte	119,413.93	932.96	.....	.....	932.96	120,346.89
Calaveras	11,774.77	39,357.85	4,387.61	.....	43,745.46	55,520.23
Colusa and Lassen	.....	3,975.46	.....	.....	3,975.46	3,975.46
Del Norte	115.52	.....	.....	.....	.....	115.52
Eldorado	2,784.61	5,502.22	.....	.....	5,502.22	8,286.83
Fresno	17.66	44.65	100.86	.....	145.51	163.17
Humboldt	1,702.12	4.98	.....	.....	4.98	1,707.10
Imperial and San Diego	.....	4,225.12	.....	.....	4,225.12	4,225.12
Inyo	.....	18,554.13	18.58	1,188.91	19,761.62	19,761.62
Kern	169.65	29,821.59	.....	.....	29,821.59	29,991.24
Madera	.....	255.47	231.96	.....	487.43	487.43
Mariposa	173.67	15,189.27	.....	.....	15,189.27	15,362.94
Merced and Stanislaus	10,361.30	.....	.....	.....	.....	10,361.30
Modoc	.....	263.06	.....	.....	263.06	263.06
Mono	.....	21,078.15	.....	.....	21,078.15	21,078.15
Monterey, San Luis Obispo, and Santa Cruz	12.09	36.91	.....	.....	36.91	49.00
Nevada	8,060.10	114,497.14	.....	.....	114,497.14	122,557.24
Placer	8,387.84	4,053.78	.....	.....	4,053.78	12,441.62
Plumas	2,268.01	6,788.14	.....	.....	6,788.14	9,056.15
Riverside	.....	270.17	.....	.....	270.17	270.17
Sacramento	67,460.73	113.05	.....	.....	113.05	67,573.78
San Bernardino	98.39	2,566.39	.34	.....	2,566.73	2,665.12
Shasta	3,277.07	44,292.63	26,624.39	.....	70,917.02	74,194.09
Sierra	3,825.01	11,269.68	.....	.....	11,269.68	15,094.69
Siskiyou	15,104.80	6,053.26	.....	.....	6,053.26	21,158.06
Trinity	18,096.26	6,132.40	.....	.....	6,132.40	24,228.66
Tuolumne	697.03	29,083.87	.....	.....	29,083.87	29,780.90
Yuba	154,797.68	209.03	.....	.....	209.03	155,006.71
Total	429,995.46	490,705.36	31,844.68	1,188.91	523,738.95	953,734.41

Comparisons of these totals for 1910 with the gold output of 1909 are as follows:

Mine production of gold in California in 1909 and 1910, with classification of source, in fine ounces.

	Placers.	Deep mines.				Grand total.	
		Siliceous ore.	Copper ores.	Lead ores.	Total.	Quantity.	Value.
1909	440,426.95	504,715.70	33,430.12	434.17	538,579.99	979,006.94	$20,237,870
1910	429,995.46	490,705.36	31,844.68	1,188.91	523,738.95	953,734.41	19,715,440
Increase (+) or decrease (−)	−10,431.49	−14,010.34	−1,585.44	+754.74	−14,841.04	−25,272.53	−522,430

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The source of placer gold, by counties and from various kinds of mines, is shown as follows:

Source of placer gold in California in 1910, by counties.

County.	Hydraulic.	Dredging.	Drift.	Surface placers.	Total.
Amador	$6,913		$10,808	$12,062	$28,883
Butte	15,775	$2,389,235	47,497	15,998	2,468,505
Calaveras	8,751	191,900	30,048	12,707	243,406
Del Norte	205			2,083	2,288
Eldorado	1,680		42,456	13,427	57,563
Fresno			291	74	365
Humboldt	35,103			83	35,186
Kern	165			3,342	3,507
Mariposa			1,590	2,000	3,590
Merced and Stanislaus		213,980		207	214,187
Monterey, San Luis Obispo, and Santa Cruz				250	250
Nevada	14,558		147,509	4,465	166,617
Placer	8,587	5,911	151,743	7,151	173,392
Plumas			17,184	29,700	46,884
Sacramento		1,369,594	12,905	12,038	1,394,537
San Bernardino				2,034	2,034
Shasta		66,368		1,375	67,743
Sierra	37,307		38,174	3,589	79,070
Siskiyou	179,165	109,182	1,618	22,339	312,244
Trinity	328,154	31,608	1,555	12,766	374,083
Tuolumne			13,461	948	14,409
Yuba		3,172,476		27,476	3,199,952
Total	635,498	7,550,254	516,929	186,114	8,888,795

The increase or decrease of gold production, by counties, in 1910 as compared with 1909, is shown in the following table:

Increase and decrease in gold production in California in 1910, by counties.

County.	Increase.	Decrease.
Amador	$347,461	
Butte		$499,288
Calaveras		292,806
Colusa, Lassen, and Modoc		28,709
Del Norte	778	
Eldorado		66,980
Fresno		14,166
Humboldt	9,599	
Imperial and San Diego	14,824	
Inyo		49,337
Kern		34,825
Madera		4,640
Mariposa		78,885
Merced and Stanislaus		14,305
Mono	80,815	
Monterey, San Luis Obispo, and Santa Cruz	680	
Nevada		126,752
Placer		24,181
Plumas	29,716	
Riverside	5,399	
Sacramento		272,940
San Bernardino	15,022	
Shasta		66,761
Sierra	122,303	
Siskiyou	21,216	
Trinity		19,195
Tuolumne		310,077
Yuba	734,408	
Los Angeles (no product in 1910)		864
Total	1,382,281	1,904,711
Total decrease		522,430

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SILVER.

The yield of silver in California in 1910 was 1,840,085 fine ounces, valued at $993,646, a decrease in quantity of 258,168 fine ounces and in value of $97,446. The larger part of the output, 1,363,668 fine ounces, valued at $736,381, was derived from the smelting of copper ores. The siliceous ore, both milled and smelted, yielded 257,355 fine ounces, valued at $138,972. The largest production from siliceous ore, 64,830 fine ounces, valued at $35,008, came from Kern County. The largest producer of silver was, as usual, Shasta County, which yielded from copper ores 1,192,520 fine ounces, valued at $643,961, and from siliceous ore 8,752 fine ounces, valued at $4,726; with the output from placer mines included, Shasta County produced altogether 1,201,676 fine ounces of silver, valued at $648,905. The silver obtained with the gold in placer mining in the State in 1910 was 41,856 fine ounces, valued at $22,602. The largest producer of placer silver was Butte County, with 11,081 fine ounces, valued at $5,984.

The following table shows the source of silver output in California in 1910, by placers and kinds of ore, by counties, in fine ounces:

Source of silver production in California by kinds of ore in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.				Grand total.
		Siliceous ore.	Copper ores.	Lead ores.	Total.	
Amador	289	22,977	13,617	.....	36,594	36,883
Butte	11,081	770	.....	.....	770	11,851
Calaveras	1,939	8,626	144,683	.....	153,309	155,248
Colusa and Lassen	.....	1,800	.....	.....	1,800	1,800
Del Norte	22	.....	.....	.....	.....	22
Eldorado	402	1,389	.....	.....	1,389	1,791
Fresno	6	115	5,596	.....	5,711	5,717
Humboldt	276	2	.....	.....	2	278
Imperial and San Diego	.....	439	.....	.....	439	439
Inyo	.....	58,874	3,902	177,206	239,982	239,982
Kern	61	64,830	.....	.....	64,830	64,891
Madera	.....	189	3,237	.....	3,426	3,426
Mariposa	22	4,355	.....	.....	4,355	4,377
Merced and Stanislaus	1,119	.....	.....	.....	.....	1,119
Modoc	.....	139	.....	.....	139	139
Mono	.....	17,391	.....	.....	17,391	17,391
Monterey, San Luis Obispo, and Santa Cruz	6	19	.....	.....	19	25
Nevada	1,383	29,183	.....	.....	29,183	30,566
Placer	937	1,206	.....	.....	1,206	2,143
Plumas	308	1,615	.....	.....	1,615	1,923
Riverside	.....	52	.....	.....	52	52
Sacramento	8,465	65	.....	.....	65	8,530
San Bernardino	20	18,689	113	.....	18,802	18,822
Shasta	404	8,752	1,192,520	.....	1,201,272	1,201,676
Sierra	398	2,065	.....	.....	2,065	2,463
Siskiyou	2,711	1,588	.....	.....	1,588	4,299
Trinity	2,037	1,592	.....	.....	1,592	3,629
Tuolumne	46	10,609	.....	.....	10,609	10,655
Yuba	9,924	24	.....	.....	24	9,948
Total	41,856	257,355	1,363,668	177,206	1,798,229	1,840,085

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Comparisons of these totals for 1910 with the silver output of 1909 are as follows:

Mine production of silver in California in 1909 and 1910, with classification of source, in fine ounces.

Year.	Placers.	Deep mines.				Grand total.	
		Siliceous ore.	Copper ores.	Lead ores.	Total.	Quantity.	Value.
1909	40,967	456,846	1,539,645	60,795	2,057,286	2,098,253	$1,091,092
1910	41,856	257,355	1,363,668	177,206	1,798,229	1,840,085	993,646
Increase (+) or decrease (−)	+889	−199,491	−175,977	+116,411	−259,057	−258,168	−97,446

COPPER.

The mine production of copper in California in 1910 from all ores was 48,700,756 pounds, valued at $6,184,996, a decrease in quantity of 8,587,525 pounds and in value of $1,262,480. Copper was produced in the counties of Amador, Calaveras, Fresno, Inyo, Madera, San Bernardino, and Shasta. The heaviest production, as in previous years, was from Shasta County, which made an output of 40,397,284 pounds, valued at $5,130,455 from 627,389 tons of ore. In 1909 this county produced 50,013,511 pounds of copper, valued at $6,501,757. The next county in importance in 1910 in the production of copper was Calaveras, with an output of 7,302,331 pounds, valued at $927,396. Fresno, Madera, Amador, Inyo, and San Bernardino follow in copper production in the order named. Calaveras is increasing in the production of this metal, the increase for 1910 having been 1,886,016 pounds in quantity and $223,275 in value. There were altogether 716,685 tons of copper ore treated in California in 1910, which is 123,673 tons less than in 1909. The copper ore in California also yielded 31,844.68 fine ounces of gold and 1,363,668 fine ounces of silver. The total yield from copper ore alone in California in 1910 in copper, gold, and silver amounted in value to $7,579,742, or $1,345,516 less than in 1909.

LEAD.

The lead production of California in 1910 was 2,870,977 pounds, valued at $126,323. This was an increase in quantity of 1,368,380 pounds and in value of $61,711. The six counties of Butte, Inyo, Kern, Plumas, San Bernardino, and Shasta were the only producers of lead in 1910, the largest quantity, as usual, coming from Inyo County, where there were 10 silver-lead mines producing. The quantity of lead ore treated in the State in 1910 was 17,904 tons, all from Inyo County, the lead produced in the other counties being only nominal in quantity and obtained merely as a by-product from treating other classes of ores. From the lead ore were obtained also 1,188.91 fine ounces of gold, valued at $24,577, and 177,206 fine ounces of silver, valued at $95,691. The total yield of the lead industry in

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1910 in California in lead, gold, and silver amounted in value to $246,591; but $42,355 of the lead value came from siliceous ore, so that the actual value of all metals in the lead ores was $204,236.

MINING INDUSTRY IN CALIFORNIA IN 1910.

The fact that California produced in 1910, in gold, silver, copper, and lead, $1,820,645 in value less than in 1909, may be largely attributed to the entire or partial cessation of operations at important copper mines, owing to legal troubles in connection with damage suits about smelter fumes. The value of the output from copper ores in gold, silver, and copper for 1910 was $1,345,516 less than that of 1909. In copper output alone there was a decrease in value of $1,262,480. The heavy falling off in gold yield from deep-mining operations in Calaveras and Tuolumne counties, however, and to a less degree in Mariposa, Eldorado, Kern, Inyo, and Shasta counties, was not nearly overcome by the increased yield from the same source in the counties of Amador, Mono, Sierra, and Plumas. In the placer mines the large reduction in yield in the dredging counties of Butte and Sacramento was more than overcome by the increase of gold from this source in Yuba County. There was a decrease of $214,339 in value of gold and silver produced by the placer mines of California in 1910 and a decrease of $405,537 in value of gold and silver from the deep mines of all classes, a total falling off for these metals of $619,876.

The situation in the copper-mining industry, whereby the smelting plants of several heavily yielding mines have had to close down owing to litigation over damage from smelter fumes, has very materially affected the gross output of the most productive county of the State—Shasta. The reduction of value of yield in that county in 1910 amounted to $1,592,609. Since the close of the year still another large mine has ceased operations entirely.

The relative percentage of output of gold from placer and deep mines was virtually the same in 1910 as in 1909. The dredging industry continues to increase in importance as the number and capacity of the dredges increase. There were some material changes in 1910 in the relative output of the principal dredging fields of the State. These are three in number: On Feather River, at Oroville, Butte County; on Yuba River, near Marysville, Yuba County; and on American River, near Folsom, Sacramento County. In Butte County there are 32 dredges at work, in Yuba County 15, and in Sacramento County 8. In the counties of Calaveras, Merced, Stanislaus, Placer, Shasta, Siskiyou, and Trinity there are very few points where there is more than one machine in operation. The oldest dredging field in the State, that at Oroville, Butte County, shows a decided reduction in gold yield for the year 1910, as the companies are working now on a poorer part of their acreage than when they first began operations. The Sacramento County field is also showing some decrease in yield. The Yuba County field, as noted more in detail in the paragraph relating to that county in this report, is materially increasing its output. The importance of the dredging industry with relation to the annual gold yield of California may be realized from the statement previously made that the dredges are

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now producing over 38 per cent of the entire gold output of the State, and nearly 85 per cent of the gold yield from the placer mines.

In the section on production by counties in this report the details of deep-mining work in the Mother Lode counties are given. A condensed statement of the record of 1910 of these Mother Lode counties is given in the following table:

Tonnage of ore and value recovered in gold in bullion, and silver mills, tonnage and value of concentrates produced, and total recovery, with average value per ton, in Mother Lode counties, California, in 1910.

County.	Ore to gold and silver mills.				Ore to concentrating mills, quantity.	Concentrates produced.				Value of total recovery.	Value of total average recovery, per ton.
	Quantity.	Gold, in bullion.	Silver, in bullion	Average value in gold and silver recovered on plates per ton.		Quantity.	Gold.	Silver.	Average value in gold and silver, per ton.		
	Short tons.		*Fine ounces.*		*Short tons.*	*Short tons.*		*Fine ounces*			
Amador	547,873	$1,655,835	15,006	$3.04	3,061	12,472	$915,600	9,759	$73.83	$2,584,809	$4.69
Calaveras	365,192	425,675	4,023	1.17	200	9,706	384,561	4,541	39.87	814,859	2.23
Eldorado	17,383	84,337	913	4.88	.....	415	29,404	476	71.47	114,491	6.59
Mariposa	42,534	283,192	3,907	6.71	.....	699	30,384	430	43.79	315,918	7.43
Tuolumne	197,515	392,970	4,926	2.00	121	5,293	207,032	5,672	39.69	605,725	3.06
Total	1,170,497	2,842,009	28,777	2.44	3,402	28,585	1,566,981	20,878	55.21	4,435,802	3.78

A comparison of this table with the corresponding table for the year 1909 shows a total decrease of tonnage milled in the five combined Mother Lode counties in 1910 of 167,663 tons, and a decrease in total output of gold and silver of $418,553. It is to be noted, however, that the average value of gold and silver recovered on the plates in 1910 was 14 cents more per ton than in 1909; the average gold and silver value of the concentrates $5.99 more per ton; and the value of the total average recovery per ton was 18 cents higher. In gold output in these counties, Amador alone showed an increase in 1910, the other four counties all showing material reductions in output.

The quantity of ore treated from the deep mines of the State in 1910 was 2,697,885 tons, or 343,803 tons less than in 1909. The Mother Lode counties are responsible for nearly half of this reduction. Shasta County, owing to the situation in copper mining, previously referred to, is responsible for nearly the other half of the decrease in onnage for 1910 in the State, only 18,217 tons being apportioned among other counties than those mentioned.

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The total tonnage, by kinds of ore treated or sold in each county in California in 1910, is shown in the following table:

Subdivision of tonnage of crude ore sold or treated in California in 1910, by counties, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Total ore.
Amador	573,749	4,185	.....	577,934
Butte	13,578	.....	.....	13,578
Calaveras	367,314	68,949	.....	436,263
Colusa and Lassen	12,102	.....	.....	12,102
Eldorado	17,383	.....	.....	17,383
Fresno	75	14,407	.....	14,482
Humboldt	10	.....	.....	10
Imperial and San Diego	44,835	.....	.....	44,835
Inyo	34,790	269	17,904	52,963
Kern	197,550	.....	.....	197,550
Madera	918	1,451	.....	2,369
Mariposa	42,703	.....	.....	42,703
Merced and Stanislaus	.....	.....	.....	.....
Modoc	774	.....	.....	774
Mono	24,913	.....	.....	24,913
Monterey, San Luis Obispo, and Santa Cruz	410	.....	.....	410
Nevada	250,358	.....	.....	250,358
Placer	15,688	.....	.....	15,688
Plumas	41,681	.....	.....	41,681
Riverside	557	.....	.....	557
Sacramento	150	.....	.....	150
San Bernardino	7,067	35	.....	7,102
Shasta	68,944	627,389	.....	696,333
Sierra	28,461	.....	.....	28,461
Siskiyou	13,331	.....	.....	13,331
Trinity	7,925	.....	.....	7,925
Tuolumne	197,737	.....	.....	197,737
Yuba	293	.....	.....	293
Total	1,963,296	716,685	17,904	2,697,885
Increase (+) or decrease (−)	−232,445	−123,673	+12,315	−343,803
Average value per ton in gold and silver	$5.23	$1.94	$6.72	.....

The subdivision of tonnage and production of gold and silver in California in 1910, according to methods of treatment, is shown in the following table:

Subdivision of tonnage and production of gold and silver in California in 1910, according to methods of treatment, by counties.

County.	Ore to gold and silver mills.			Concentrates produced.		
	Tonnage.	Gold.	Silver.	Tonnage.	Gold.	Silver.
			Fine ounces.			*Fine ounces.*
Amador	547,873	$1,655,835	15,008	12,472	$915,600	9,759
Butte	1,652	15,173	98	6	992	150
Calaveras	365,192	425,675	4,023	9,706	384,561	4,541
Colusa and Lassen	12,102	82,180	1,800	.....	.....	.....
Eldorado	17,383	84,337	913	415	29,404	476
Fresno	75	743	102	1	180	13
Humboldt	10	103	1	.....	.....	.....
Imperial and San Diego	44,835	87,341	439	.....	.....	.....
Inyo	32,667	373,751	11,582	111	3,796	696
Kern	191,656	594,129	54,170	51	5,349	1,945
Madera	918	5,281	189	.....	.....	.....
Mariposa	42,534	283,192	3,907	699	30,384	430
Modoc	724	5,108	131	.....	.....	.....
Mono	24,051	428,734	12,170	70	4,000	354
Monterey, San Luis Obispo, and Santa Cruz	410	763	19	.....	.....	.....
Nevada	250,132	2,008,215	16,277	4,192	334,550	12,065
Placer	15,571	78,610	1,119	168	3,340	37

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Subdivision of tonnage and production of gold and silver in California in 1910, according to methods of treatment, by counties—Continued.

County.	Ore to gold and silver mills.			Concentrates produced.		
	Tonnage.	Gold.	Silver.	Tonnage.	Gold.	Silver.
			Fine ounces.			*Fine ounces.*
Plumas	41,681	$139,124	1,589	30	$1,199	26
Riverside	557	5,585	52	.....	.....	.....
Sacramento	150	1,531	30	41	806	35
San Bernardino	3,018	29,819	6,280	.....	.....	.....
Shasta	60,036	774,280	6,428	401	50,709	457
Sierra	26,442	220,324	1,943	35	2,305	22
Siskiyou	13,224	114,499	1,453	40	4,463	63
Trinity	7,855	114,394	1,286	28	1,816	56
Tuolumne	197,515	392,970	4,926	5,293	207,032	5,672
Yuba	293	4,321	24	.....	.....	.....
Total	1,900,556	7,926,017	145,959	33,699	1,980,486	36,797
Average value per ton	.....	$4.17	$0.04	.....	$58.77	$0.56

County.	Crude ore to smelters.			Old tailings treated.		
	Tonnage.	Gold.	Silver.	Tonnage.	Gold.	Silver.
			Fine ounces.			*Fine ounces.*
Amador	1,160	$8,929	11,045	25,820	$36,999	782
Butte	1	83	1	11,925	3,038	521
Calaveras	69,051	91,053	144,708	1,820	3,010	37
Colusa and Lassen	.....	.....	.....	.....	.....	.....
Eldorado	.....	.....	.....	.....	.....	.....
Fresno	14,407	2,085	5,596	.....	.....	.....
Humboldt	.....	.....	.....	.....	.....	.....
Imperial and San Diego	.....	.....	.....	.....	.....	.....
Inyo	19,143	29,962	226,452	1,153	1,000	1,252
Kern	28	661	6,935	5,866	16,328	1,780
Madera	1,451	4,795	3,237	.....	290	.....
Mariposa	1	124	5	168	.....	13
Modoc	.....	.....	.....	50	330	8
Mono	62	2,005	609	800	985	4,258
Monterey, San Luis Obispo, and Santa Cruz	.....	.....	.....	.....	.....	.....
Nevada	.....	.....	.....	226	24,101	841
Placer	17	1,399	22	100	450	28
Plumas	.....	.....	.....	.....	.....	.....
Riverside	.....	.....	.....	.....	.....	.....
Sacramento	.....	.....	.....	.....	.....	.....
San Bernardino	229	3,133	11,463	3,855	20,107	1,059
Shasta	636,251	640,769	1,194,217	46	227	170
Sierra	.....	.....	.....	19	10,336	100
Siskiyou	12	6,170	72	.....	.....	.....
Trinity	70	10,558	250	.....	.....	.....
Tuolumne	1	785	6	100	430	6
Yuba	.....	.....	.....	.....	.....	.....
Total	741,884	802,511	1,604,618	51,948	117,631	10,855
Average value per ton	.....	$1.08	$1.16	.....	$2.26	$0.11

Average recovery per ton from bullion and concentrates: Gold, $5.20; silver, $0.05. There were 3,497 tons of crude ore sent to mills using concentration alone.

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Reports were received from 1,079 producing mines in California in 1910, as shown by the following table:

Number of producing mines in California, classified by chief product in 1910, by counties.

County.	Placer mines.					Deep mines.					Total mines reporting product.
	Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Copper.	Silver.	Silver lead.	Total.	
Amador	3	.....	8	5	16	33	1	.....	.....	34	50
Butte	5	32	14	16	67	9	.....	.....	.....	9	76
Calaveras	1	4	14	20	39	31	1	.....	.....	32	71
Colusa and Lassen	.....	.....	.....	.....	.....	3	.....	.....	.....	3	3
Del Norte	2	.....	.....	5	7	.....	.....	.....	.....	.....	7
Eldorado	3	.....	15	18	36	28	.....	.....	.....	28	64
Fresno	.....	.....	2	1	3	5	1	.....	.....	6	9
Humboldt	14	.....	.....	1	15	1	.....	.....	.....	1	16
Imperial and San Diego	.....	.....	.....	.....	.....	4	.....	.....	.....	4	4
Inyo	.....	.....	.....	.....	.....	21	2	.....	10	33	33
Kern	1	.....	.....	5	6	41	.....	4	.....	45	51
Madera	.....	.....	.....	.....	.....	4	1	.....	.....	5	5
Mariposa	.....	.....	1	4	5	33	.....	.....	.....	33	38
Merced and Stanislaus	.....	2	.....	1	3	.....	.....	.....	.....	.....	3
Modoc	.....	.....	.....	.....	.....	4	.....	.....	.....	4	4
Mono	.....	.....	.....	.....	.....	12	.....	.....	.....	12	12
Monterey, San Luis Obispo, and Santa Cruz	.....	.....	.....	1	1	2	.....	.....	.....	2	3
Nevada	3	.....	6	3	12	37	.....	.....	.....	37	49
Placer	9	1	36	18	64	15	.....	.....	.....	15	79
Plumas	.....	.....	14	20	34	12	.....	.....	.....	12	46
Riverside	.....	.....	.....	.....	.....	3	.....	.....	.....	3	3
Sacramento	.....	8	6	2	16	1	.....	.....	.....	1	17
San Bernardino	.....	.....	.....	2	2	17	1	5	.....	23	25
Shasta	.....	4	.....	4	8	34	4	.....	.....	38	46
Sierra	14	.....	13	10	37	24	.....	.....	.....	24	61
Siskiyou	73	4	4	19	100	46	.....	.....	.....	46	146
Trinity	40	2	2	9	53	24	.....	.....	.....	24	77
Tuolumne	.....	.....	4	2	6	37	.....	.....	.....	37	43
Yuba	.....	15	.....	19	34	4	.....	.....	.....	4	38
Total	168	72	139	185	564	485	11	9	10	515	1,079

PRODUCTION BY COUNTIES.

AMADOR COUNTY.

The most productive of the Mother Lode counties of California is Amador.

Mine production of Amador County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1909	111,203.72	$2,298,785	32,118	$16,701	113,995	$14,819	$2,330,305
1910	128,012.16	2,646,246	36,883	19,917	151,480	19,238	2,685,401
Increase (+)	+16,808.44	+347,461	+4,765	+3,216	+37,485	+4,419	+355,096

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In 1909 the value of the output of Amador County was increased over that of 1908 by $433,528, so that in two years, including the increase for 1910, there has been a total increase in value of output of $788,624. This increase has been almost entirely due to the success attending the very deep mining operations on the more extensive mines of the Mother Lode, and may be considered a matter of great encouragement to owners of Mother Lode properties in other counties where developments have not been carried on to so great a depth or extent. The increase in 1910 was not only in gold, but in silver and copper as well. There were 16 productive placer mines in the county and 34 deep mines, 50 in all. The total output of ore of the county was 577,934 tons, which was the largest of any in the State where gold mining is mainly carried on. There was an increase in output of 97,260 tons in 1910.

Of the total output, 1,154 tons of copper ore were shipped to smelters, and 547,873 tons, or 94.8 per cent of the total tonnage, was treated at gold and silver mills. From this milling ore $1,655,835 in gold and 15,008 ounces of silver was saved as bullion, an average gold value of $3.02 per ton, and an average silver value of a little in excess of $0.01 per ton. The total gold and silver obtained as bullion was valued at $1,663,939, an average of a little over $3.03 per ton. From this milling ore and 3,081 tons of ore sent to concentrating mills were obtained 12,472 tons of concentrates, which yielded $915,600 in gold, an average of $73.41 per ton, and 9,759 ounces of silver, or an average value of 42 cents per ton, a total average value of $73.83 per ton in gold and silver. The total extraction of gold from bullion and concentrates was $2,571,435, an average of $4.66 per ton, and the total recovery of silver was 24,767 ounces, an average value of $0.025 per ton. The value of the total yield of both gold and silver from milling ore and ore to concentrating mills was, therefore, $2,584,809, an average value of $4.69 per ton. The yield of the placers of the county was 1,397.22 fine ounces of gold, valued at $28,883, and 289 ounces of silver, valued at $156. Of the placers, 3 were hydraulic mines, 8 drift, and 5 sluicing properties.

In 1910 the deep mines at Amador City produced 99,459 tons of ore, yielding $439,820 in gold, and 3,928 fine ounces of silver, valued at $2,121, a total value of $441,941. Of the deep mines at this place, the Bunker Hill Consolidated is the most important, and is developed through an inclined shaft 2,000 feet deep. To the 20-stamp amalgamating and concentrating mill, 20 stamps were added in February, 1911, all run by electric power. The mine has also an extensive tailings plant. The Keystone, one of the oldest quartz mines in the State, has a 60-stamp mill which was operated four months in 1910. The Original Amador Mining Co. has a 20-stamp amalgamation and concentration mill, which was operated the entire year. The 800-foot inclined shaft of this company was deepened by 70 feet during the year. In Defender district are the Defender mine of the Gold Ridge Mining Co., and the Katherine mine. At Drytown are the Gover, North Gover, Loyal Lode, and Fremont mines, all worked as one property by the Fremont Consolidated Mining Co., which is developing them through 2 incline shafts, 1,550 feet and 1,700 feet deep, respectively. The property is equipped with a 40-stamp amalgamating and concentrating mill.

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Near Ione the Ione Coal & Iron Co. is operating a copper mine whose ores carry also gold and silver, which are concentrated on Pindar and Frue tables, the product being shipped to a smelter. The district around Jackson is the most important in the county; in it there was a production in 1910 of $1,365,845 in gold and of 11,500 fine ounces of silver, valued at $6,213, a total of $1,372,058. This production came from the Amador Queen No. 2, Argonaut, Kennedy, Oneida, Valparaiso, Zeila, Zeila slimes plant, and a few small mines. The Argonaut has an inclined shaft 3,675 feet deep at 60° incline. The 3,450-foot and 3,600-foot levels were opened in 1910. The mill of this company has 40 stamps and was worked the entire year. The Kennedy is one of the most important producers in the State and has a vertical shaft 3,555 feet deep; the lowest level being worked is at 3,450 feet vertical. The mill has 100 stamps. The Zeila is also an important mine. The Red Cloud hydraulic mine is at Lancha Plana, and the Clarke drift mine is at Oleta. The Dane-Mitchell mine, having a 10-stamp amalgamation mill, is at Pine Grove. At Plymouth are the Chadbourne, Levaggi, Mont de Oro, and O'Brien deep mines. At Sutter Creek are the Central Eureka, South Eureka, Petersen, and some small quartz properties. The Central Eureka has a 40-stamp amalgamating and concentrating mill. The South Eureka, with a 62° incline shaft 2,780 feet deep, has an 80-stamp amalgamating and concentrating mill. The few quartz mines at Volcano are small ones; the Cleveland and the Grillo are productive drift mines. Among nonproducers, operators of the Treasure at Amador City sunk 400 feet of new shaft in 1910 and will continue to 1,000 feet before making a station. Several hydraulic mining operators have been stopped by the California Débris Commission from further operations.

BUTTE COUNTY.

Mine production of Butte County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1909	144,490.95	$2,987,079	13,856	$7,205	.....	.....	$2,994,284
1910	120,346.89	2,487,791	11,851	6,400	659	$29	2,494,220
Increase (+) or decrease (−)	−24,153.06	−499,288	−2,005	−805	+659	+29	−500,064

Butte County in 1910 showed a decrease in value of total production of $500,064, most of which was in gold. This was entirely due to the lessened output in the dredging industry, more particularly in the Oroville field, the pioneer dredging field in California.

The productive mines in this county comprise 5 hydraulic mines, 32 dredges, 14 drift mines, 16 surface or sluicing mines, and 9 deep mines—76 in all. The dredges produced in gold $2,389,235 in 1910, or $501,038 less than in 1909. There were two more dredges operating in the county in 1910 than in 1909. The hydraulic mines produced $15,775 in gold in 1910, the drift mines $47,497, and the surface mines $15,998. The total output of gold from placers of all kinds was valued at $2,468,505. The deep mines of the county

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produced $19,286 in gold. Oroville has been for some years the most productive gold field in the State, but the dredges on the Yuba River, near Marysville, are now making a larger combined annual output. The following table shows the output of gold from the Oroville dredging field for several years past, with increase or decrease:

Gold output of Oroville, Cal., dredging district, 1903–1910, with increase (+) or decrease (−), by years.

1903	$1,329,998	
1904	1,632,507	+$302,509
1905	2,261,887	+ 629,380
1906	2,768,782	+ 506,895
1907	2,697,092	− 71,690
1908	3,043,151	+ 346,059
1909	2,743,232	− 299,919
1910	2,099,628	− 643,604

This table applies to the dredges at Oroville alone, there now being in Butte County six dredges at work in outside districts. The combined output of these outside dredges in 1910 was $289,607 in gold, as compared with $147,041 in 1909.

In 1910 the following dredging companies were operating in the Oroville field: Boston and California; Boston and Oroville; Butte; El Oro; Gold Run; Indiana; Natomas Consolidated of California; Oroville Dredging & Exploration; Oro Water, Light and Power; Pacific; Ophir; Pennsylvania; and Viloro Syndicate. Some of these companies own several dredges. The companies in Wymans Ravine, Honcut, and other "outside" districts are the Bucket Gravel (an experimental machine), Gardella, Honcut, Kentucky Ranch, Leggett Gold, and Butte Creek Consolidated. Several new dredges were built in the county in 1910, while others suspended operations, having worked out their acreage. The main cause of the decrease in output from the dredges is that when they were first started the best ground of their acreage was selected for working, and that now many are handling ground which pays less to the cubic yard than that on which operations were commenced.

As to other placer operations, the Big Blue Lead Co. is doing some extensive hydraulicking at Bangor. At Berdan the Allen and the Smith are small gravel mines. The Cherokee is a hydraulic mine at the town of the same name. At Clipper Mills, Enterprise, and Forbestown the mines are small sluicing properties. At Inskip are the Adler Creek, Sky High, and Willow Creek mines. The Mineral Slide is at Magalia, and the Alvarado hydraulic mine is at Nimshew. At Stirling City the mines are all surface placers. Of the deep mines the Crystal Peak, at Enterprise, has a 5-stamp mill and the Triumph, at Lumpkin, has a 2-stamp mill. The other deep mines are all small producers.

CALAVERAS COUNTY.

Mine production of Calaveras County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1909	69,684.72	$1,440,511	137,342	$71,418	5,416,315	$704,121	$2,216,050
1910	55,520.23	1,147,705	155,248	83,834	7,302,331	927,396	2,158,935
Increase (+) or decrease (−)	−14,164.49	−292,806	+17,906	+12,416	+1,886,016	+223,275	−57,115

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The gold output of Calaveras County in 1910 decreased by $292,806, but the silver yield increased 17,906 fine ounces in quantity, and in value $12,416, and the copper production increased 1,886,016 pounds in quantity, and $223,275 in value, the total decrease of value of the county output in 1910 being $57,115. There were 71 productive mines reporting in the county, of which 32 were deep and 39 were placers. Of the latter 1 is a hydraulic mine, and there are 4 dredges, 14 drift, and 20 sluicing mines. There was a decrease of 23 productive mines, which in large measure accounts for the reduction in gold yield. The total ore output fell off 130,402 tons in 1910.

The total tonnage of ore in Calaveras County was 436,263 short tons, yielding 43,745.46 fine ounces of gold, valued at $904,299; 153,309 fine ounces of silver, valued at $82,787, and 7,302,331 pounds of copper, valued at $927,396.

The output of placer gold was 11,774.77 fine ounces, valued at $243,406, and of placer silver 1,939 ounces, valued at $1,047.

The total output of the county in 1910 in gold, silver, and copper was valued at $2,158,935.

There were 365,192 tons of ore treated at gold and silver mills, being 83.7 per cent of the tonnage of the county in 1910. From this was obtained gold in bullion valued at $425,675, or $1.16 per ton, and 4,023 ounces of silver valued at $2,171—less than 1 cent per ton in value by silver. The total saving in bullion was valued at $427,846, or $1.17 per ton. From these 365,192 tons and 200 tons sent to concentrating mills, 9,706 tons of concentrates were produced, yielding $384,561 in gold and 4,541 ounces of silver, a total value of $387,013, and an average of $39.62 per ton in gold and $0.25 per ton in silver, or a total average value of $39.87 per ton. The milling ore yielded a total of $810,236 in gold, the total average recovery per ton being $2.22. Of silver the total average recovery was a little over 1 cent per ton. The total gold and silver recovered was therefore valued at $2.23 per ton.

The principal producing deep mines of the county are at Angels, and the mines of this district produced 206,078 tons of ore in 1910, which yielded $517,655 in gold and 5,250 ounces of silver. The Utica and Gold Cliff mines with 100 stamps were closed down for 5 months owing to lack of water, and this affected smaller mines as well. The Angels also was not worked full time. Operators of the Lightner, formerly a large producer, with a 60-stamp mill, did only development work during the last two months of the year. The result of this comparative inactivity was that the mines at Angels produced 143,057 tons less of ore in 1910 than in 1909, and $270,343 less gold. The decrease in gold yield of the county for 1910 is therefore almost entirely accounted for in this district alone. At the North Star mine, owned by the Dolling Gold Mining Co., a 30-stamp mill was started up after the close of the year, and operators of the Bruner and Romaggi mines, 2 miles south of Angels, have started work on two new shafts. At the Waterman, adjoining the Gold Cliff mine, of the Utica Co., development work has been begun since the close of the year 1910. The Penn Chemical Co. at Campo Seco, has a 130-ton reverberatory furnace, and a 70-ton blast furnace for handling copper ores. The Gwin mine continued idle, though at one time it was a very large producer. Dissensions among stockholders is given as the cause of

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the idleness of the property. The Melones Mining Co. has an inclined shaft 800 feet deep, and a 7,000-foot tunnel, and takes all the ore from the Reserve mine. The company has a 100-stamp mill with concentrators. At the Quartz Glen mine at Mokelumne Hill there was a 10-stamp mill to which have been added 10 stamps. The mine is worked by a series of tunnels. The Outlook Mining Co., working the Easzy Bird mine, has also 10 stamps in its mill and the plant is to be enlarged. The Clary Mining Co. at Murphy also has a 10-stamp mill working ores from the Washington mine. The Sheep Ranch Co. has a 20-stamp mill, which was only run a few months in 1910. In placer gold the hydraulic mines yielded $8,751; the dredges $191,900; the drift mines $30,048; and the surface placers $12,707, a total of $243,406. The more important placers are those of the Calaveras Gold Dredging Co. and of the Isabel Gold Dredging Co., at Jenny Lind; the Anderson drift mine, Calaveritas Hill or Nelson, the properties of the California Engineering Co., and of the Channel Mining Co. (Square Head), at San Andreas; and of the Mokelumne Mining Co. (dredge) at Wallace. The Fine Gold Mining Co. at Vallecita, now idle, never obtained any gold from its hydraulic mine less than 0.955 fine, and did obtain it is high as 0.993 fine, equal to $20.52 per troy ounce.

ELDORADO COUNTY.

Eldorado, which is one of the five Mother Lode counties of California, in 1910 produced 8,286.83 fine ounces of gold, valued at $171,304, and 1,791 fine ounces of silver, valued at $967, a total value of $172,271, or $67,312 less than in 1909. The ore mined, amounting to 17,383 tons, was all treated at gold and silver mills. The gold saved on plates was $84,337, or an average of $4.85 per ton, and 913 ounces of silver, valued at $493, was recovered, the total recovery from the plates being valued at $84,830, an average value of $4.88 per ton. There were 415 tons of concentrates derived from the milling ore, which yielded $29,404 in gold and 476 ounces of silver, a total value of $29,661 in gold and silver, or $70.85 per ton in gold, and $0.62 in silver, an average value of $71.47 per ton in both gold and silver. The ore milled yielded, therefore, on the plates and from the concentrates, a total of $113,741 in gold, or an average per ton of $6.54; and silver was valued at $750, or $0.04 per ton, or a total value of gold and silver of $114,491, or $6.58 per ton, a slightly higher average than in 1909, when the average was $6.42 per ton.

The placer mines of the county yielded 2,784.61 fine ounces of gold, valued at $57,563, and 402 ounces of silver, valued at $217. Of the gold, $1,680 came from 3 hydraulic mines, $42,456 from 15 drift mines, and $13,427 from 18 surface or sluicing mines. There were 64 producing mines in the county in 1910, of which 28 are deep and 36 are placers.

The principal producing deep mines in the county are the Good Luck, at Diamond Springs, equipped with a 5-stamp mill, which was operated for 8 months in 1910; the Eldorado Consolidated, at Eldorado; the Mount Pleasant, at Grizzly Flats; and the Sherman, at Placerville, which has a 10-stamp mill. The other deep mines are smaller producers and are operated at Eldorado, Georgetown, Greenwood, Grizzly Flats, Josephine, Jurgens, Latrobe, Pilot Hill, Pleasant

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Valley, Rescue, and Salmon Falls. The more prominent placers are the Gold Channel, the Pacific and Watson, at Georgetown; the Excelsior drift mine of the Eldorado Water & Deep Gravel Mining Co., and the Landecker drift, at Placerville.

DEL NORTE AND HUMBOLDT COUNTIES.

There are no deep mines in Del Norte County and the few placers, 2 hydraulic, and 5 sluicing claims, made a total yield of $2,388 gold and of 22 ounces of silver, with a total value of $2,400, as compared with a total of $9,742 in 1909. The producing mines were all in the vicinity of Crescent City.

Humboldt County made a total production in gold and silver valued at $35,439, as compared with $26,278 in 1909, a gain of $9,161 in 1910. The yield of quartz gold and silver was nominal, but the 14 hydraulic mines yielded $35,103 in gold, and the 1 surface placer $83. Nearly all the producing mines are at Orleans, although there are a few at China Flat and Weitchpec. The principal producers in the county are the California Mining & Dredging Syndicate, the Pearch, and the Salstrom, all hydraulic, at Orleans.

FRESNO COUNTY.

The production of Fresno County in 1910 in gold, silver, and copper was valued at $68,274, as compared with $218,263 in 1909—a decrease which may be charged to inactivity in copper mining in 1910. There were only 3 small placers worked in 1910, and 6 deep mines. The placers were at Friant and Tollhouse and the deep mines at Auberry, Clovis, Letcher, Friant, and Ockenden. Some development work is being carried on in a small way in several mines.

INYO COUNTY.

Mine production in Inyo County, Cal., in 1909 and 1910.

Metal.	1909		1910		Increase (+), decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	22,148.30	$457,846	19,761.62	$408,509	− 2,386.68	−$49,337
Silver.....do....	90,609	47,117	239,982	129,590	+ 149,373	+ 82,473
Copper.....pounds..	31,722	4,124	58,047	7,372	+ 26,325	+ 3,248
Lead.....do....	1,490,649	64,098	2,866,894	126,143	+1,376,245	+ 62,045
Total.....	.....	573,185	.....	671,614	.....	+ 98,429

There were 33 productive deep mines in Inyo County in 1910, but no placers. Of the deep mines 21 were gold, 2 copper, and 10 silver-lead. The total value of the output was $671,614, which is $98,429 in excess of that of 1909. There was a falling off of $49,337 in gold, but the silver increased by 149,373 fine ounces in quantity and $82,473 in value, the copper by 26,325 pounds in quantity and $3,248 in value, and the lead by 1,376,245 pounds in quantity and $62,045 in value. There were treated in 1910 in Inyo County 52,963 short tons of ore, of which 34,790 tons were siliceous, 269 tons were copper ores, and 17,904 tons were lead ores. The deep mines in 1910

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yielded 19,761.62 fine ounces of gold, valued at $408,509. The silver yield was 239,982 fine ounces, valued at $129,590. Of gold, 18,554.13 fine ounces, valued at $383,548, were obtained from the siliceous ore; from copper ores were obtained 18.58 fine ounces, valued at $384; and the lead ores yielded 1,188.91 ounces, valued at $24,577. The silver production from the siliceous ore was 58,874 fine ounces, valued at $31,792; from the copper ores 3,902 ounces, valued at $2,107; and from the lead ores 177,206 ounces, valued at $95,691. The siliceous ore yielded, therefore, a total value of $415,340 in gold and silver; the copper ores yielded a total of $2,491; and the lead ores $120,268, a total of $538,099 in gold and silver for the county. The few mines worked at Ballarat made only a small production. At Darwin and vicinity the Inyo Coso, Inyo County Development Co., New Coso, Yucca and Villa Real of the Domingo Mining Co., produced 758 tons of ore, which yielded $5,358 in gold, 17,448 ounces of silver, 904 pounds of copper, and 270,609 pounds of lead, with a total value of $26,802. At Independence, the Knudsen, Minetta, and Wood mines were small producers. In the Keeler district, the Ella, Shady and Perseverance, Four Metals, Reed, Old Coso, and Townsend produced 543 tons of ore, yielding $1,274 in gold, 26,270 ounces of silver, 14,626 pounds of copper, and 543,662 pounds of lead, the total value being $41,236 for the district. At Lee and Lone Pine the output was small in gold and silver. In Skidoo district, of the few productive mines, the Skidoo Mines Co., operating the Golden Eagle group, made by far the largest output. These mines are developed by a vertical shaft 300 feet in depth and a tunnel 1,500 feet long. They have a 50-ton stamp mill with concentrators and cyanide plant. Skidoo is now, next to Tecopa, the most productive camp in Inyo County. At Tecopa the Tecopa Consolidated Mining Co., operating the Gunsight and Noonday mines, produced all but a few thousand dollars of the value of the total district output in 1910. The Keane Wonder mine (the nearest post office to which is Rhyolite, Nev.) is developed by a 200-foot shaft and tunnels aggregating 1,500 feet in length. It is equipped with a 20-stamp amalgamating mill and a cyanide plant for working tailings. The mine is one of the larger producers of the county. Among other producers is the Chloride Cliff mine, owned by the Penn Mining & Leasing Co., and the Frazier and Ibex mines at Zabriskie. A number of former producers like the Arondo at Searles, Golden Argus at Ballarat, Reward at Independence, and Southern Belle at Laws, reported no output for 1910.

KERN COUNTY.

Mine production of Kern County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1909	31,675.90	$654,799	195,448	$101,633	.....	.....	$756,432
1910	29,991.24	619,974	64,891	35,041	569	$25	655,040
Increase (+) or decrease (−)	−1,684.66	−34,825	−130,557	−66,592	+569	+25	−101,392

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The gold output of Kern County was $619,974 in 1910, or $34,825 less than in 1909, and the silver output was 64,891 fine ounces, valued at $35,041, a decrease of 130,557 ounces in quantity and of $66,592 in value. There was a nominal output of lead in 1910, and there was none in 1909. There were 45 deep mines producing and 6 placers. These placers, at Isabella, Ricardo, Weldon, and Woody made a combined output of $3,507 in gold and 61 ounces of silver. There were treated 197,550 tons of siliceous ores and tailings, of which 28 tons were crude ore sent to the smelter, 5,866 tons were old tailings, and 191,656 tons were crude ore treated at gold and silver mills. The yield in bullion from the ore to gold and silver mills was $594,129 in gold, or $3.10 per ton in average value and 54,170 ounces of silver, making a total bullion value of $623,381 in gold and silver, with an average value per ton of $3.25. From this ore was derived 51 tons of concentrates yielding $5,349 in gold and 1,945 ounces of silver, making a total value of $6,399, with an average value of $125.47 in gold and silver per ton. From the 5,866 tons of old tailings was produced $16,328 in gold and 1,780 ounces of silver, giving a total value of $17,289, or an average of $2.95 in gold and silver per ton. The 28 tons of ore sent to the smelter yielded $661 in gold and 6,935 ounces of silver, with an average value per ton, respectively, of $23.60 and $133.75, or a total value of $4,406 in gold and silver, averaging $157.35 per ton. The total yield for the county in gold and silver from deep mines was $651,475, making an average of $3.30 per ton of ore treated.

Randsburg is the most productive district in the county and the mines there in 1910 produced 177,035 tons of ore, yielding $520,842 in gold and 9,404 fine ounces of silver, valued at $5,078, a total of $525,920, as compared with a total of $518,635 in 1909.

The Butte Lode, under lease in 1910, is developed by a number of inclined shafts from 100 to 600 feet in depth. The 10-stamp mill of the Baltic was not operated in 1910, but the cyanide plant was used for 7 months. The Yellow Aster Mining Co., owning 40 mining claims in one group, worked its property mostly by "glory hole" with chutes dropping the ore to the tunnel level. The company has one 100-stamp and one 30-stamp mill. This is the largest mine in the camp, and the most productive in southern California. Among other producers in Randsburg were the Baltic lease, Gold Bug, Gold Brick, Jordan, Josephine group, Merced, Santa Ana, Pearl Wedge, Sydney group, Sunshine, and Stanford. In Isabella district the New Century, Mammoth, Keyes, Silverado Mountain, and King produced 852 tons of ore, yielding $15,208 gold and 1,448 ounces of silver, or a total value of $15,990. In Piute district the Bryan Chief, Kern-Piute, Lone Pine and Razzle Dazzle, Monte Cristo, and Skinner mines produced a total value of $11,039 in gold and silver. Other producing mines are the Gold Peak (silver) and Provident (silver), at Amalie; Portuguese and White Star, at Bodfish; Pearl, at Caliente; San Antonio, at Tehachapi; and Tropico, at Rosemond. The closing down of the 100-ton dry crushing and cyaniding plant of the Queen Esther at Mohave, and the suspension of work in the middle of the year was the cause of the large falling off in silver production of the county, and also of the decrease in gold output in 1910.

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MARIPOSA COUNTY.

Mariposa, one of the Mother Lode counties of California, produced in 1910 gold and silver valued at $319,944, or $79,250 less than in 1909. The output of gold in 1910 was 15,362.94 fine ounces, valued at $317,580 and that of silver 4,377 ounces valued at $2,364. The gold production from deep mines was 15,189.27 fine ounces, valued at $313,990, and the silver output 4,355 ounces, valued at $2,352. The placer gold output amounted to 173.67 fine ounces, valued at $3,590, and the placer silver production was 22 ounces, valued at $12. The deep mines produced 42,535 tons of ore, 1 ton of which went to the smelter, and 168 tons of old tailings were worked during the year. The 42,534 tons of ore which went to the gold and silver mills yielded $283,192 in gold as bullion, averaging $6.66 per ton, and 3,907 ounces of silver, valued at $2,110, the total gold and silver value of the mill bullion being $285,302, or an average of $6.71 per ton. From this tonnage were also derived 699 short tons of concentrates, which yielded $30,384 in gold and 430 ounces of silver, a total value of $30,616. The concentrates therefore yielded $43.47 in gold and 32 cents in silver per ton, an average yield of $43.79 per ton in both gold and silver. The siliceous ore yielded on the plates and from the concentrates a total value of $315,918 in gold and silver, or an average total value of ore treated of $7.43 per ton.

Thirty-eight mines were productive in the county in 1910, of which 33 were deep gold mines and 5 were placers, the latter being all slucing mines with the exception of 1 drift property. These small placers are at Briceburg, Jerseydale, Mariposa, and Whitlock.

Hornitos is the most productive district in the county, and its mines made a production in 1910 of 15,328 tons of ore, yielding $88,490 in gold and 861 ounces of silver, valued at $465, a total of $88,955, as compared with a total of $223,461 in 1909. This was derived from the Mount Gaines, Treasure, Bates, Hornitos, Beauty, "1909," and Ruth Pierce mines. At the Mount Gaines, which has a 20-stamp amalgamating and concentrating mill, the shaft was deepened 400 feet in 1910. The Treasure has a 5-stamp mill, and the "1909" has one of 8 stamps. There was only half the tonnage milled at the Hornitos mines in 1910 that there was in 1909. The mines at Coulterville produced $60,398 in gold and 1,591 ounces of silver, valued at $859, a total value of $61,257 in 1910, as compared with a total of $27,033 in 1909. This increase of $34,224 was due to the operations of the Hasloe and Century, Blair, Black Jack, Champion, Empire group, Hill, Reich, and Webb mines, several of which are "pocket" mines, where large yields are obtained from small quantities of ore. Other producers are the Sierra Rica at Briceburg; Crown Lead and Grub Stake, at Bagby; Specimen, at Bear Valley; Early and Revel, at Jerseydale; Trujillo, at Kinsley; and Farmers Hope, at Whitlock. The most important mines in the county are those owned by the Mariposa Commercial & Mining Co., on the Mariposa grant. They have a 40-stamp mill on the Princeton mine, a 10-stamp mill at Mount Bullion, and a 5-stamp mill at Bagby. A large amount of development work was done in 1910 on the Pine Tree and Josephine vein systems and at the Long Mary mine. The Mountain King Mining Co. has a 24-stamp mill at Mountain

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King. The Penon Blanco group at Coulterville, long idle, has changed hands, and plans are being prepared for mill machinery. A mill is also being operated on the San Domingo, at Briceburg.

MONO COUNTY.

In 1910 Mono County produced metal valued at $445,115, as compared with a total of $393,175 in 1909, an increase of $51,940. This is rather a surprising result considering that the tonnage of ore treated in 1910 was only 24,913 tons, whereas it was 48,536 tons in 1909. The gold derived from the 24,913 tons of ore treated was 21,078.15 fine ounces, valued at $435,724, and the silver, 17,391 ounces, valued at $9,391. No output of either copper or lead was reported from the county in 1910, although there were small quantities in 1909. There were 12 deep mines producing, but no placers.

Bodie is the most important district, and in 1910 the product was 14,518 tons of ore, which yielded $303,539 in gold and 11,122 ounces of silver, valued at $6,006, a total value in gold and silver of $309,545, as compared with $252,247 in 1909. By far the largest proportion of this was derived from the properties of the Standard Consolidated Mining Co., which alone produced $294,823 in gold and $5,896 in silver, as shown by its published reports. Among other producers in the county are the Rose of the West and the St. Ives, at Benton; the Dawn of Hope mine, of the Casa Diablo Mining Co.; a few small properties at Lundy; and the Pittsburg-Liberty at Masonic, the second largest producer in the county. The Casa Diablo Co. has a 10-stamp mill which was started up in June, 1910; arrangements have been made to increase the capacity of the reduction plant.

NEVADA COUNTY.

Mine production of Nevada County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		
1909	128,688.86	$2,660,235	47,935	$24,926	$2,685,161
1910	122,557.24	2,533,483	30,566	16,506	2,549,989
Decrease	6,131.62	126,752	17,369	8,420	135,172

In Nevada County the metallic output for 1910 showed a decrease in value of $135,172 from that of 1909. This was entirely due to the very material decrease of $227,997 in the placer gold yield, there having been in 1909 a remarkable yield from one drift mine, in which extensive and rich pockets were found. The deep mines of the county increased their gold output by $101,245 in 1910. The total falling off in silver output was 17,369 fine ounces in quantity and $8,420 in value. The tonnage treated in 1910 was 250,358 short tons, as compared with 232,034 in 1909, an increase of 18,324 tons in 1910. There were 49 productive mines in the county in 1910, of which 37 were deep mines and 12 placers. Of the placers 3 were hydraulic, 6 drift, and 3 sluicing mines. The placer gold aggregated

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in value $166,617, of which $14,553 was derived from hydraulic mines, $147,599 from drift, and $4,465 from sluicing properties. The deep mines produced 114,497.14 fine ounces of gold, valued at $2,366,866, and 29,183 fine ounces of silver, valued at $15,759, a total value of $2,382,625.

Nevada County, which has for many years held the first rank in production of gold from deep mines, was in 1910 passed by Amador County, the deep mines from which yielded $250,497 more gold than those in Nevada County.

There were 250,132 tons of siliceous ore treated at gold and silver mills, and 226 tons of old tailings worked in the county in 1910. The value of gold in the mill bullion was $2,008,215, or $8.03 per ton, and the silver output from the same source was 16,277 ounces, valued at $8,790, or less than 4 cents per ton. The total value of the gold and silver recovered in the mill bullion was $2,017,005, or an average of $8.06 per ton. From the mill ore there was obtained 4,192 tons of concentrates which yielded $334,550 in gold, or an average of $79.81 per ton, and 12,065 ounces of silver, valued at $6,515, or an average of $1.55 per ton. The total value of concentrates was $341,065 in gold and silver, or an average value of $81.36.

From the total tonnage, including tailings, and from bullion and concentrates $2,366,866 in gold was recovered, or an average of $9.45 per ton, and silver valued at $15,759, or an average of $0.06 per ton.

The value of the total gold and silver obtained as bullion and from concentrates was $2,382,625, the average of all the tonnage treated being $9.51 per ton in gold and silver. In 1909 the average value of all ores milled in the county was $9.86 per ton in gold and silver. In 1908 it was $10.14, in 1907 it was $9.06, and in 1906 it was $8.74 per ton.

The principal quartz-mining district of Nevada County is that of Grass Valley, which includes the mines in both Grass Valley and Nevada City. The following table shows the production of Grass Valley district in 1909 and 1910:

Production of Grass Valley and Nevada City quartz mines, Nevada County, Cal., 1909 and 1910.

Year.	Grass Valley mines.			Nevada City mines.			Grand total.
	Gold.	Silver.	Total.	Gold.	Silver.	Total.	
1909	$2,005,574	$16,540	$2,022,114	$171,604	$1,971	$173,575	$2,195,689
1910	2,113,499	13,101	2,126,600	118,688	1,731	120,419	2,247,019
Increase (+) or decrease (−)	+107,925	−3,439	+104,486	−52,916	−240	−53,156	+51,330

The Grass Valley deep mines increased the value of their output for 1910 by $104,486, and the Nevada City mines decreased their yield in the same period by $53,156. The increase in yield from the mines of the entire district was valued at $51,330. The total output treated in the district was 198,498 tons, of which 175,450 tons came from the Grass Valley mines and 23,048 from those of Nevada City. The North Star Mines Co., at Grass Valley, is the most productive deep gold mine in California. The Grass Valley

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quartz mines produced 70.1 per cent of the tonnage of the whole county, and the mines of Nevada City 9.2 per cent, the district of Grass Valley having therefore produced 79.3 per cent of all the ores milled in Nevada County in 1910. The Grass Valley deep mines produced $2,113,499, or 89.3 per cent of the quartz gold obtained in Nevada County in 1910, and 83.1 per cent of the quartz silver, or 89.25 per cent of the total value derived from quartz ores.

The Nevada City deep mines produced $118,688, or 5 per cent of the quartz gold obtained in the county, and 11 per cent of the quartz silver. This was a little over 5 per cent of the total value derived from quartz ores of the county.

Grass Valley district (including the Grass Valley and Nevada City mines) produced 94.3 per cent of the quartz gold, 94.1 per cent of the quartz silver, and 94.3 per cent of the total values derived from quartz mining operations in Nevada County in 1910.

The producing quartz mines in Grass Valley district in 1910 were the Bryden, Cassidy Consolidated, Central Consolidated, Empire, Idaho-Maryland, Kenebec, North Star, Prudential, Pennsylvania Consolidated, Rough and Ready, Sultana, and Union Hill. Of these the Central Consolidated has a 20-stamp mill which was worked only a portion of the year, owing to scarcity of water for amalgamation. The Empire has a 40-stamp mill and a 75-ton cyanide plant, which was added during the year. The Idaho-Maryland has a 20-stamp mill. This mine has an incline shaft 1,000 feet deep, and the winze from the 1,000-foot level is 1,110 feet deep. The North Star Mines Co. has two 40-stamp mills with concentrator and 2 plants treating mill tailings and concentrates. The main shaft is 5,300 feet deep on an incline of 27°, and a vertical shaft 1,600 feet deep meets the incline at a point 4,000 feet from the outcrop. For the year 1910 the North Star mines produced gold and silver of a total value of $1,232,933, at a cost for current operation of $505,792 and for development $50,068, leaving an available profit of $677,073. This production was wholly derived from the North Star mine and was obtained from 90,110 tons of ore milled, with an average yield of $13.68 per ton, and an average cost of $5.61 per ton for current operation and $0.55 for development, making an average cost of $6.11 and leaving a realized profit of $7.51 per ton over all costs of operation and development. The Prudential mine has a 12-stamp mill, the Pennsylvania 20 stamps, the Sultana 20 stamps, and the Union Hill 10 stamps. The deep mine producers at Nevada City are the Champion, Lecompton, Mountaineer, Oustomah, Pittsburg-Gold Flat, and Zeibright. Of these the Champion has a 40-stamp, a 30-stamp, and a 20-stamp mill. The Mountaineer has a 10-stamp mill, with 8 concentrators and a sand plant; a new shaft was completed and new hoisting plant installed during the year. The Pittsburg-Gold Flat has a 20-stamp mill, and a new hoist was added in 1910. The Zeibright has a 10-stamp mill. At Gaston the Gaston Co. has a 40-stamp amalgamating and concentrating mill. At Graniteville the Ancho, Birchville, Erie Consolidated, Lew, and Republic mines made a combined output of 21,834 tons of ore, yielding $50,233 in gold and 470 ounces of silver, valued at $254. Operators of the Erie Consolidated have a 30-stamp mill and are reopening an old mine. The Republic has 10 stamps added to its mill, and the Birchville has the same number. The Yuba Consolidated, at Maybert, had a 20-stamp mill running in 1910 and a 10-stamp mill idle.

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The new tunnel being run at this mine is to be 2,000 feet long. The Consolidated St. Gothard mine, at North Columbia, is equipped with a 20-stamp mill. There were 2 producing deep mines at Washington, the Ethel, with 10 stamps, and Fairview, with 20 stamps. French Corral is the only camp in the county having more than two producing placers; it has three, which had a total output of $8,975 in gold in 1910. The Brunswick Consolidated, at Grass Valley, was engaged in sinking a new 3-compartment shaft in 1910; hence it milled no ore.

PLACER COUNTY.

In 1910 Placer County produced gold and silver valued at $258,348, as against $282,864 in 1909. The total gold yield in 1910 was 12,441.62 fine ounces, valued at $257,191, and the silver was 2,143 ounces, valued at $1,157. The deep mines produced from 15,688 tons of siliceous ore, 4,053.78 fine ounces of gold, valued at $83,799 and 1,206 fine ounces of silver, valued at $651. The placer-mine yield was 8,387.84 fine ounces of gold, valued at $173,392, and 937 ounces of silver, valued at $506. Of this placer gold $8,587 was derived from hydraulic mines, $151,743 from drift mines, and $13,062 from dredging and sluicing operations. There were 64 placer mines and 15 deep gold mines productive in the county in 1910. The most productive deep mine in the county was the Helester (or Rawhide), at Towle, which is developed by 3 tunnels 2,780 feet long; about 1,500 feet of tunneling was done during the year. The mine has a 10-stamp mill with concentrators. Among the other more important deep mines were the Bellevue Consolidated, at Newcastle; Crater Hill, at Ophir (since closed down permanently); Orpheum, at Ophir; Black Hawk, at Towle; and Herman, at Westville.

The drift mines and small placers at Bullion, as well as those near Auburn, made a much smaller output in 1910 than in 1909, and all the mines at Butcher Ranch and Colfax were small ones. At Dutch Flat the combined yield from 3 drift mines was $3,878. At Forest Hill 12 mines made a combined yield of $19,719. These included the Paragon, Ceanothers, Dardanelles, De Maria, Eureka Consolidated, Hop Sing, Kiser, Lehigh Canyon, El Dorado placer, and Solari. At Gold Run the Canyon Creek, Gold Nugget, Long Ravine, Oregon Gulch, Washington, and United Water & Power Co. made a combined output of $4,455 in gold and silver. In Iowa Hill district, $51,465 in gold and 352 ounces of silver valued at $190 was obtained from the Carrie, McGeachin, Jupiter, McGeachin lease, San Francisco, and Selby drift mines. In Last Chance district, $66,374 in gold and 261 ounces of silver valued at $141 was produced by the following drift mines: Frankmont (or Home Ticket), Bill Anderson, Dixie Queen, Lucky Strike (Glen Consolidated), Morning Star, Placer Gravel, and Pacific Slab Consolidated. At Lincoln and Loomis the placers are all small ones, with the exception of the Barton drift mine at the latter place. The yield of the Big Gun, Bigelow, and Bogus Thunder mines at Michigan Bluff was $8,051 in gold and 37 ounces of silver valued at $20. At Wimer and Westville the placer mines are unimportant.

PLUMAS COUNTY.

The total yield from the mines in Plumas County in 1910 was valued at $188,294, as compared with $158,078 in 1909, an increase of

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$30,216. The gold production was 9,056.15 fine ounces, valued at $187,207, and the silver production 1,923 ounces, valued at $1,038. There were 41,681 tons of siliceous ore treated at the mills, which yielded 6,788.12 fine ounces of gold, valued at $140,323, and 1,615 ounces of silver, valued at $872. The placer mines yielded 2,268.01 fine ounces of gold, valued at $46,884, and 308 ounces of silver, valued at $166. There were 12 producing deep mines and 34 placers. Of the latter, 14 were drift mines, yielding $17,184 in gold, and 20 sluicing mines, yielding $29,700. More gold was derived from the drift mines in 1910 than in 1909, but considerably less came from the surface sluicing mines. No hydraulic mines produced in 1910.

The deep-mining operations were mainly confined to Johnsville and vicinity, that district having produced 36,111 tons of ore yielding $108,129 in gold, and 800 ounces of silver, valued at $432. Of the deep mines of the district the most productive was the Jamison, which has a 20-stamp amalgamating mill with concentrators, but they are not used, the concentrates being of too low grade to pay any profit. The mill was not run full time during the year owing to shortage of water for power. The Plumas-Eureka mines changed hands in 1909 after 10 years of practical idleness, and a good portion of 1910 was spent in putting the property in condition for production. The main tunnel of this mine is 5,500 feet long and the developments on the property are very extensive, there being 26 miles of development work in adits, winzes, stopes, and inclines, 7 to 8 miles of which are in working shape. The mine is equipped with a 40-stamp amalgamating and concentrating mill. Other deep mines at Johnsville are the Four Hills, with a 20-stamp mill, and several small claims. At Eclipse is the Rose Quartz Co., which has a Knight ball mill. The Granite Cape, Bluff City, and Crescent Hill mines are at Quincy. The mill of the Crescent Hill was operated for only three months in 1910. The Seneca Mining Co. at Seneca has a 6-stamp amalgamating mill. This is an old placer region, but a large amount of money was spent in 1910 in developing lode prospects and drift mines.

At Belden the Long Bar placer was productive in 1910, and at Buck are the Greenbower, Newton, and New York placer mines. At Crescent Mills are 3 small drift mines, and the placers at Johnsville are not large producers. At La Porte the placer mines yielded $23,539 in gold and 137 ounces of silver valued at $74. These mines are the Alturas, French, Menifee, Angora Creek, Robert Creek, Secret Diggings, and Bernard Diggings. The largest returns were derived from tailings of old hydraulic mines. At Meadow Valley, Nelson, and Prattville are a few small placers, as well as at Quincy and Seneca.

SACRAMENTO COUNTY.

Mine production of Sacramento County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		
1909	80,777.25	$1,669,814	5,492	$2,856	$1,672,670
1910	67,573.78	1,396,874	8,530	4,606	1,401,480
Increase (+) or decrease (−)	−13,203.47	−272,940	+3,038	+1,750	−271,190

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Sacramento County showed the largest county increase in gold output in the State in 1909, but in 1910 it showed a decrease of $272,940 as compared with 1909. The decrease from drift mines was $102,338 from dredges $164,542, and from sluicing mines $8,397. No hydraulic mines were operated, and production was reported from only one deep mine. The total gold yield of the county in 1910 was 67,573.78 fine ounces of gold, valued at $1,396,874, and the silver yield was 8,530 ounces, valued at $4,606, a total value of $1,401,480, as compared with $1,672,670 in 1909. There were 8 dredges operating in the county in 1910, 6 drift mines, and 2 surface placers or sluicing properties, all except one at Michigan Bluff being near Folsom or Natoma.

SAN BERNARDINO COUNTY.

In 1910 San Bernardino County produced 2,665.12 fine ounces of gold, valued at $55,093; 18,822 ounces of silver, valued at $10,164; 5,992 pounds of copper, valued at $761; and 1,545 pounds of lead, valued at $68; a total of $66,086. This is $6,324 less than the total output of 1909. In gold production the county showed an increase of $15,022, but the copper production fell off to the extent of 142,320 pounds, and there were 5,351 ounces less silver in 1910 than in 1909. There were 23 deep mines and 2 surface placers reporting production in 1910. Of the deep mines, 17 were gold, 1 copper, and 5 silver. There were 7,102 tons of material treated in 1910, of which 3,018 tons of ore were sent to gold and silver mills, 229 tons were crude ore to smelters, and 3,855 tons were old tailings. The increase in tonnage was 2,653 short tons.

There were no large producers among the deep mines of the county, and the largest returns obtained from any one property were from the old tailings dump of the Bagdad-Chase Mining Co. near Barstow. There is a 50-stamp mill on this property with a cyanide plant equipped with tank capacity of 1,100 tons. The tailings were cyanided, the percolation method being used. Next in order of output was the Supply mine of the Seal of Gold Mining Co. at Dale, the "O. K." mine of that company not having been operated. The ore was worked in a 6-stamp mill. The "M. K." Mining Co. at Victorville and the Big Chief Mining Co. at Hart were the next operators in rank of production. Among other producing deep mines are the Calzona mines at Calzona; Death Valley Arcalvada at Cima; Earl, Oriental, Paradise Mountain, and Waterloo at Daggett (all silver mines); Eaton group at Silver Lake; and Gold Mountain at Victorville. The few placers are at Coolgardie.

SHASTA COUNTY.

Mine production of Shasta County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1909	77,423.65	$1,600,489	1,414,346	$735,460	50,013,511	$6,501,757	.....	.....	$8,837,706
1910	74,194.09	1,533,728	1,201,676	648,905	40,397,284	5,130,455	196	$9	7,313,097
Increase (+) or decrease (−)	−3,229.56	−66,761	−212,670	−86,555	−9,616,227	−1,371,302	+196	+9	−1,524,609

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Shasta County is the most productive in metallic output in the State, its total output for the year 1910 being valued at $7,313,097, or over $4,000,000 more than the value of any other county output. Nevertheless, Shasta showed a decrease of $1,524,609 in value of total yield in 1910 as compared with 1909. This large decrease is entirely due to curtailment of operations at some of the larger copper mines of the county, owing to litigation and resultant injunctions through alleged damage done to the agricultural interests by the fumes from the smelters. Not only were the copper mines themselves affected, but many gold and silver mines which supplied ore to the smelters for fluxing, etc., have been closed down. The falling off in gold yield in Shasta County in 1910 was $66,761; in silver, 212,670 ounces in quantity and $86,555 in value; and in copper 9,616,227 pounds in quantity and $1,371,302 in value. It is to be noted, therefore, that most of the decrease in total value in the county is due to the reduced yield of copper.

The total number of deep mines from which production was reported in 1910 was 38, of which 34 were gold mines and 4 were copper mines.

The tonnage output of the county was the largest in the State, being altogether 696,333 tons, of which 627,389 tons were copper ore and 68,944 tons were siliceous ore.

From the deep mines of the county were obtained 70,917.02 fine ounces of gold, valued at $1,465,985, and from the placers 3,277.07 fine ounces, valued at $67,743. These placers included 4 dredges and 4 sluicing mines. The deep mines yielded 1,201,272 fine ounces of silver, valued at $648,687, and the placers 404 ounces, valued at $218.

The gold obtained from siliceous ore amounted to 44,292.63 fine ounces, valued at $915,610, and that derived from copper ores was 26,624.39 fine ounces, with a vlaue of $550,375. The silver production from siliceous ore was 8,752 fine ounces, valued at $4,726, and that from copper ores 1,192,520 ounces, valued at $643,961. The siliceous ore, therefore, yielded $920,336 in gold and silver, and the copper ores yielded $1,194,336, a total of $2,114,672 in gold and silver from the deep mines.

Gold and silver mills in Shasta County in 1910 treated 60,036 tons of ore, which yielded in gold bullion $774,280, an average in value of $12.90 per ton, and 6,428 ounces of silver, valued at $3,471, an average value of $0.06 per ton. The total recovery as mill bullion was valued at $777,751, an average value in gold and silver of $12.96 per ton.

This ore produced 401 tons of concentrates, with a gold value of $50,709, and 457 ounces of silver, valued at $247, or a total value in concentrates of $50,956. The average value per ton of the concentrates was $126.46 in gold, $0.61 in silver, a total average value of $127.07 per ton.

The total gold value of the ore treated at gold and silver mills was $824,989, an average of $13.74 per ton, and the total silver value was $3,718, or $0.06 per ton, a total gold and silver value from mill bullion and from concentrates of $828,707, or an average recovery of $13.80 per ton.

The crude ore sent to smelters, amounting to 636,251 tons, produced (in addition to the copper), $640,769 in gold, an average of $1.01 per ton, and 1,194,217 ounces of silver, valued at $644,877, or $1.01 per ton. The total value of gold and silver recovered from the ore sent to smelters was $1,285,646, or an average value of $2.02 per ton.

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There were treated in the county 46 tons of old tailings in 1910, which yielded $227 in gold and 170 ounces of silver valued at $92, or a total value of $319.

The largest gold production from any one district in Shasta County was from French Gulch, where 44,567 tons of ore in 1910 yielded $560,144 in gold and 4,683 ounces of silver valued at $2,529. The heaviest producer in the district was the Gladstone mine of the Hazel Mining Co., which is developed by a vertical shaft 800 feet deep and a tunnel 3,600 feet long, and is equipped with a 30-stamp amalgamating mill with 8 concentrators. The next mine in rank of production in the district was the Milkmaid, of the Western Exploitation Co., which has a 10-stamp mill. Other deep mine producers in the district are the Black Sentinel, Niagara, Brunswick, Drunken Gulch, El Dorado and Eureka, Empire, Highland, Red Gulch, Summit Gulch, and Washington. Another large producer among the gold mines of the county is the Midas at Harrison Gulch district (Knob post office), which is equipped with a 20-stamp mill and concentrators. Other producers were the Original Quartz Hill at Buckeye; Bennington group of the Pittsburg & Mount Shasta Mining Co. at Keswick, Crown Deep mine of the Gold Leaf Consolidated Mining Co., the Minneshasta, and the Gambrinus, or Shasta Monarch, at Shasta; and the Banghart, or Mad Mule, at Stella. In the Whitehouse district 1,833 tons of ore were produced, yielding $19,409 in gold and 506 ounces of silver valued at $273, from the following mines: Evening Star, Reid, and the Walker mine of the Utah & California Mining Co.

Of the copper smelting companies the Balaklala Consolidated Copper Co., at Kimberly, has a 1,250-ton smelter, now closed down, owing to injunctions against the company for damage by smelter fumes. The Mammoth Copper Mining Co., at Kennett, the most productive mining property in the State, has 5 furnaces and 2 converter stands, the blister copper produced being shipped for refining to Chrome, N. J. A bag house was constructed in 1910 to save the fumes, but the capacity of the smelter was reduced by action of farmers in complaint against smelter fumes July 1, 1910. The Mountain Copper Co. worked the Iron Mountain, No. 8, and Hornet mines, at Iron Mountain, but the ore is not reduced at the mines, the 300-ton smelter being about 250 miles from the mines at Point Lewis, near Martinez, on the shores of San Francisco Bay. The blister copper produced, containing gold and silver, is shipped to Baltimore for refining. The Bully Hill Copper Mining & Smelting Co. worked the Rising Star, Bully Hill, and Copper City mines; the ore was reduced at the 350-ton smelter at Winthrop, the matte being sold to the Mammoth Copper Co.

Of the dredging plants in operation the only one which made a large output was that of the Shasta Dredging Co., on Clear Creek, near Horsetown, in the Centerville district. Work was carried on for 12 consecutive months. The Consolidated Gold Dredging Co. operated in Sacramento River near Redding for two months; the United States Gold Dredging Co., near the same place, for three months; and the Yosemite Investment Co. worked a suction dredge for three months of the year on Sacramento River, 2½ miles from Redding.

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SIERRA COUNTY.

The total production of Sierra County in 1910 was valued at $313,365, as compared with $190,629 in 1909, an increase for 1910 of $122,736. Of the total increase $122,363 was in output of gold. The yield of the county in 1910 was 15,094.69 fine ounces of gold, valued at $312,035, and 2,463 ounces of silver, valued at $1,330. There were 28,461 tons of siliceous ore treated in Sierra County in 1910, yielding 11,269.68 fine ounces of gold, valued at $232,965, and 2,065 ounces of silver, valued at $1,115. The gold output from placers was 3,825.01 fine ounces, valued at $79,070, and the silver 398 ounces, valued at $215. Of this placer gold $37,307 was taken from 14 hydraulic mines, $38,174 from 13 drift mines, and $3,589 from 10 sluicing mines, there being 37 placers reporting product. Of deep gold mines 24 were productive. The deep mines in 1910 produced $153,895 in gold more than the placers, whereas in 1909 the placer-gold yield was of greater value. The gold yield from deep mines increased in 1910 by $146,625, while the placer-gold yield during the same period decreased by $24,262. The deep mines in Allegheny district produced 7,485 tons of ore, yielding $110,558 in gold and 976 ounces of silver, valued at $527, a total value of $111,085, which was more than double the deep-mine yield of that locality in 1909. The principal mines making this output were the Croesus mine, which has a 20-stamp amalgamating and concentrating mill, and the Sixteen-to-one. At Downieville deep mines produced 492 tons of ore, yielding $41,029 in gold and 283 ounces of silver, valued at $153. These mines were the Grey Eagle, Mexican, Sovereign, and the Standard. At Forest the Kate Hardy and the Amethyst were the principal producers. At Pike the Sierra Mining Co. has a 20-stamp amalgamating and concentrating mill. The mines at Sierra City produced 10,262 tons of ore, valued at $22,567 in gold, and 363 ounces of silver, valued at $196. These were the Butte Saddle, Hayes Consolidated, Keystone, Phoenix-Buttes, Sierra Buttes, and Chipps mine of the Swastika Mining Co. The Keystone has a 10-stamp mill; the Phoenix-Buttes a mill of 20 stamps.

The placer mines at Downieville yielded $14,141 in gold and 113 ounces of silver, valued at $61, from the following mines: Best Chance, Eclipse, Hilo, and Telegraph drift. Eight small mines at Sierra City yielded $3,650 in gold, and 4 mines at Table Rock yielded $12,064 in gold. The last-mentioned mines are the Bruckeman, Soldier Boy, and Winkeye. Other placer producers are the Morning Glory, at Allegheny; Brandy City hydraulic, at Brandy City; Depot Hill hydraulic, near Camptonville; Bellevue drift mine, near Gibsonville (the most productive placer mine in the county); the Cleaveland, of the Neocene Mining Co., at Scales; and the Caledonia, at St. Louis.

SISKIYOU COUNTY.

In 1910 Siskiyou County produced 21,158.06 fine ounces of gold, valued at $437,376, and 4,299 ounces of silver, valued at $2,322, a total value of $439,698, as compared with $418,305 in 1909. This was an increase in value for 1910 of $21,393, all of which was for g,old except $177. The 46 deep mines of the county yielded from 13,331 tons of ore 6,053.26 fine ounces of gold, valued at $125,132, and 1,588 ounces of silver, valued at $858, a total value of $125,990, as com-

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pared with $188,239 in 1909. The 100 producing placers yielded 15,104.80 fine ounces of gold, valued at $312,244, and 2,711 ounces of silver, valued at $1,464, a total value of $313,708, as compared with $230,066 in 1909. The placers thus yielded $187,718 more in value of gold and silver than the deep mines in Siskiyou County in 1910. The placer output is apparently increasing in Siskiyou County, while that from the deep mines is decreasing. There were 146 productive mines in Siskiyou County in 1910, which was 67 more than in any other county of the State, Placer County being next in rank with 79 mines. Of the placers in Siskiyou County the 73 hydraulic mines produced $179,105 in gold, the 4 dredges $109,182, the 4 drift mines $1,618, and the 19 sluicing or surface mines $22,339. The number of hydraulic mines increased by 21 in 1910, and their output increased in value $65,801. The dredge-gold output in 1910 was $59,959 more than in 1909. There was very little difference in the drift-mine gold yield in the two years, but the sluicing-mine output of gold decreased by $41,874 in 1910. There are numerous placers in the county, as stated, but none of them are very large producers. There are no Federal restrictions on hydraulic mining in this county, as there are in the drainage basins of San Joaquin and Sacramento rivers, none of the rivers being navigable or liable to damage from mining débris.

Of the deep-mine operators the Mono Mining Co., of Yreka, was the most productive in the county. There are no extensive reduction works in the county, most of the mills being small ones of 5 to 10 stamps. At Callahan the Adeline Ricks, Helena or McKean, and McFadden mines produced 1,223 tons of ore, yielding $13,137 in gold and silver. At Etna Mills the Advance, Eaton group, Finley and Johnson, Highland, Homestake, Lucky Strike, and Taylor Lake made a combined output of $15,630 in value of gold and silver from 968 tons of ore. At Fort Jones the output of the few deep mines was 2,052 tons of ore, yielding $12,190 in value of gold and silver. At Yreka the Andrews, Triangle, Elk Creek, Le May, Mono, and Red Ant produced 5,447 tons of ore, yielding $41,021 in gold and 611 ounces of silver, valued at $330, a total value of $41,351. Other deep mines are worked on a small scale at Cecilville, Forks of Salmon, Gilta, Greenview, Hawkinsville, Hornbrook, Oak Bar, Oro Fino, Rollin, Sawyers Bar, Scott Bar, Seiad, and Snowden.

Of the placers the largest producers are the North California Mining Co. (dredge), at Croy; the Siskiyou Dredging Co. (dredge), at Fort Jones; the Forks of Salmon River Mines Co., at Sawyers Bar; the Bloomer and Horn Bar hydraulic, at Forks of Salmon; and the Scott River Dredging Co. (dredge), at Callahan.

Of the principal placer districts in the county the Fort Jones district produced $68,755 in gold; Sawyers Bar, $47,354; Forks of Salmon, $23,727; Callahan, $22,532; Scott Bar, $14,216; Yreka, $11,349; Hawkinsville, $12,398; Happy Camp, $11,200; Walker, $5,339; and Black Bear, $4,729. Placer mines were also worked productively at Cecilville, Gazelle, Greenview, Hilts, Hutton, Hornbrook, Oak Bar, Seiad, and Somesbar.

TRINITY COUNTY.

In 1910 Trinity County produced 24,228.66 fine ounces of gold, valued at $500,851, and 3,629 ounces of silver, valued at $1,960, a total value of $502,811, which was $19,537 less than the total of 1909.

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There were 77 mines producing in this county in 1910, of which 24 were deep and 53 were placers. The deep mines produced 7,925 tons of ore, which yielded 6,132.40 fine ounces of gold, valued at $126,768, and 1,592 ounces of silver, valued at $860, a total value of $127,628, as compared with a total value of $152,897 in 1909. The 53 placers yielded 18,096.26 fine ounces of gold, valued at $374,083, and 2,037 ounces of silver, valued at $1,100, a total of $375,183. The 40 hydraulic mines yielded $328,154 in gold; the 2 dredges, $31,608; the 2 drift mines, $1,555; and the 9 sluicing mines, $12,766. In hydraulic mining Trinity stands first among the counties of the State, the largest hydraulic mine in the United States—the La Grange—being in this county. In Trinity, as in Siskiyou County, there are no restrictions requiring the impounding of the mining débris, as in most of the California counties, as these counties are outside the drainage basins of Sacramento and San Joaquin rivers where the Government restrictions apply to this character of gravel mining in navigable streams.

The principal producing deep mines of the county are at Deadwood, where 2,723 tons of ore were produced which yielded $49,158 in gold. The mines there are the Brown Bear, Blue Jay, California-Michigan, and Leas and Nicholson. The largest producer among the deep mines is the Globe, at Dedrick; and the Five Pines and Surprise mine at Trinity Center is also a prominent producer. Other productive deep mines are the Golden Jubilee, New Blue Jay, and Oro Grande, at Carrville; Mountain Boomer, at Denny; Gold Bug and Yellow Rose, at Dorleska; Colling Bros. and Dixie Queen, at Douglas City; Fritz, Grizzly, and Jolly Rose, at Helena; Wilson and Paulsen, at Lewiston; and Quimby, at Quimby.

Of the placers of the county, the most productive, as has been the case for some years, is the La Grange hydraulic mine near Weaverville. Other notable hydraulic producers in the county are the Union Hill, at Douglas City; Hupp group, at Weaverville; Sykes, at Trinity Center; Fortune Teller, at Big Bar; Chapman and Fisher, at Junction City; and Trinity Placer Syndicate, at Coffee. At Big Bar three placers produced $7,905 in gold. At Coffee 4 mines yielded $12,526. At Douglas City the Indian Creek, Steiner's Flat, Union Hill, and Spring Gulch made a combined production of $39,598 in gold. At Hayfork the Blue Gravel, Carrier Gulch, Stafford and Whipple, and Bowers produced in all $3,903. The placers at Junction City, which together yielded $27,868 gold, were the Burgess, Chapman & Fisher, Dolly Varden, Dannenbrink, Frank, Barthol, and Valdor. At Lewiston the China Bar, Eastman Gulch, Jim Sing, and Poker Bar placer yielded $6,214 in gold. The most productive placer district was that of Weaverville, where the Homestake-Ellerbrook, Hupp group, Jose, Lucky Strike, and La Grange made a combined output of $219,325 in gold. Other placers were worked at Burnt Ranch, Carrville, Denny, Dedrick, Helena, Minersville, and Trinity Center.

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TUOLUMNE COUNTY.

Mine production of Tuolumne County, Cal., in 1909 and 1910.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		
1909	44,780.88	$925,703	8,430	$4,384	$930,087
1910	29,780.90	615,626	10,655	5,754	621,380
Increase (+) or decrease (−)	−14,999.98	−310,077	+2,225	+1,370	−308,707

The gold output of Tuolumne County decreased in 1910 by $310,077, but the yield of silver increased 2,325 ounces in quantity and $1,370 in value, making a decrease of total value of output of the county of $308,707 in 1910. In 1910 the county mines produced 29,780.90 fine ounces of gold, valued at $615,626, and 10,655 ounces of silver, valued at $5,754, a total value in gold and silver of $621,380. There were 37 deep producing mines in the county, 11 less than in 1909, and 6 placer mines, a total of 43. Four of the placers were drift mines and 2 were sluicing mines. The combined production of these placers in 1910 was $14,409 in gold and 46 ounces of silver valued at $25. With the exception of one at Tuolumne City the producers were all at Columbia. By far the largest placer producer was the Springfield Tunnel Co.

The total tonnage sold or treated in the county in 1910 was 197,737 tons of ore, of which 100 tons were old tailings. One ton was sent to the smelter, 121 tons were treated at mills for concentration only, and the remainder was treated in gold and silver mills. The 197,515 tons treated at gold and silver mills yielded in bullion $392,970 in gold, an average of $1.99 per ton, and 4,926 ounces of silver valued at $2,660, averaging $0.01 per ton, a total saved in mill bullion valued at $395,630, or an average of $2 per ton in gold and silver.

From this milling ore and ore to concentrating mills, 5,293 tons of concentrates were obtained, which yielded $207,032 in gold, an average of $39.11 per ton, and 5,672 ounces of silver, valued at $3,063, an average of $0.58 per ton, or a total value of $210,095 in gold and silver, and a total average yield of $39.69 per ton.

The ore milled and concentrated yielded a total of $600,002 in gold, or an average of $3.03 per ton, and 10,598 ounces of silver, valued at $5,723, or $0.03 per ton. The total yield of gold and silver on the plates and from concentrates was valued at $605,725, or an average yield of $3.06 per ton.

The 100 tons of old tailings yielded $430 in gold and 6 ounces of silver, or a total value of $433.

It is to be noted that the ore output of the county fell off 90,881 tons in 1910, as compared with that of 1909. Omitting 1 ton of ore sent to smelter, and 100 tons of tailings, in the ores treated at gold and silver mills, and sent to concentrating mills, the average recovery per ton in gold and silver in the county was valued at $3.06 as compared with $3.18 in 1909. Both decrease in tonnage and decrease in average value fully explain why the total yield in gold and silver in the county fell off so materially in 1910.

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The most productive deep mine in the county in 1910 was the Harvard at Jamestown. In Big Oak Flat district the Big Casino, Leithold, and two pocket mines produced 3,214 tons of ore, yielding $9,185 in gold. The Big Casino has a 20-stamp mill. At Shawmut the Eagle-Shawmut mine has a 100-stamp mill, with concentrators and a chlorination plant. The mine was in operation less than three months in 1910, owing to repair work and shortage of water supply. The Harvard at Jamestown has a 60-stamp mill. At Quartz the Dutch Consolidated has a 20-stamp mill, erected in 1910; this mine has been closed down since 1906 and was reopened during 1910. At the same place the Nevills Investment Co. (old App Consolidated) had a 60-stamp mill. In the Sonora district 7 pocket mines produced $28,203 from 21 tons of ore. At Soulsbyville the Soulsby mine of the Bagdad-Chase Co. has a 15-stamp mill, and the Black Oak also has a mill. The Mohican, at Tuolumne City, with a 5-stamp mill, was only operated 6 months and on day shift. At Tuttletown 8 small mines produced 909 tons of ore, which yielded $13,375 in gold.

Among the unproductive mines of the county the United Gold Mining Co. continued development work on the Tarantula mine throughout the year, but did not complete its new 20-stamp mill in 1910. The Densmore, at Columbia, was not reopened until December and the 10-stamp mill was not run. Work to reopen the old Jumper mine at Stent was commenced by the Jumper California Gold Mines Co., of Paris, France, in November, 1910.

YUBA COUNTY.

In 1910 Yuba County produced more gold than any other county in California, the total being $3,204,273, all with the exception of $4,321 from placer operations, mainly dredges. The increase in gold production of $734,408 in 1910 was also larger than that of any other California county. It is noteworthy that the first record of any gold dredging in this county was in 1903, when $25,736 in gold was recovered by that system of mining, while in 1910 the output of gold by dredges in the county was $3,172,476. A more marked instance could scarcely be cited of the changes which may be wrought by improvement in systems and appliances of mining. For many years Yuba was famous for the output of its hydraulic mines, but the Sawyer decision in the North Bloomfield case closed its big properties and it was not thought the Yuba auriferous gravels could ever be worked on a large scale again. However, the introduction of the gold dredge has permitted the working of gravels which even the hydraulic nozzle could not wash, and that they are being profitably mined is shown by the large and increasing annual output of gold.

Yuba County produced 155,006.71 fine ounces of gold in 1910, valued at $3,204,273, and 9,948 ounces of silver, valued at $5,372. The deep mines of the county at Brownsville, Browns Valley, and Dobbins produced 293 tons of ore, yielding 209.03 fine ounces of gold, valued at $4,321, and 24 ounces of silver, valued at $13, a total value of $4,334.

Of the 34 placer mines in operation, 15 are dredges and 19 are surface or sluicing mines. None of these placers are important producers except the dredges, only $27,476 of the placer gold having come from the sluicing mines. The most important gold producer

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in the county and in the State is the Yuba Consolidated Goldfields, which had 12 dredges at work in 1910, and has since added another, the largest ever built. In this dredge field along Yuba River, near Marysville, the dredges are of very large capacity and much more expensive than most of those in other fields. The Bear River dredge of the Oroville Dredging Co. (Ltd.), which was operating 5 miles east of Wheatland, ceased operations permanently September, 1910, having worked out its ground. The work done during the year was on the county line of Yuba and Placer counties, and while the dredge boat was floating in a pond in Placer County, the digging buckets were working in gravel on the Yuba County side of the line.

OTHER COUNTIES.

Colusa, Lassen, and Modoc counties.—These three counties are here combined, owing to the small number of mines in each. In Colusa County the only productive deep mine in 1910 was the Manzanita, at Sulphur Creek. In Lassen County the producers are the Lassen Mining Co. at Hayden Hill and a small property at Susanville. In Modoc County the producers are the Hess and the Kergel at Adin, and the Hoag Mining Co. and Fort Bidwell Mines Co. at Fort Bidwell. The combined output of these counties in 1910 was 12,876 tons of ore, which yielded 4,238.52 fine ounces of gold, valued at $87,618, and 1,939 ounces of silver, valued at $1,047, a total value of $88,665, as compared with $117,790 in 1909. The only important one of these productive mines, the property of the Lassen Mining Co., of Lassen County, has closed down, owing to a fire which destroyed much of its surface property.

Imperial, Riverside, and San Diego counties.—These are three adjoining counties in the extreme southern portion of the State, where there are very few productive mines, these being all deep mines. In Imperial County there is 1 productive mine at Picacho; there are 3 in San Diego, 1 at Escondido, and 2 at Julian; and 3 in Riverside, 1 at Banning and 2 at Perris. The figures of Imperial and San Diego Counties are combined since one of the counties has only 1 mine, as stated. The output of these two counties in 1910 was 4,225.12 fine ounces of gold, valued at $87,341, and 439 ounces of silver, valued at $237, a total of $87,578. The larger part of this output was from the mines of the Picacho Basin Mining Co. Riverside County made a total production of 557 tons of ore, yielding 270.17 ounces of gold, valued at $5,585, and 52 ounces of silver, valued at $28, a total value of $5,613, as compared with $2,305 in 1909.

Madera, Merced, and Stanislaus counties.—The output of these adjoining counties is combined to avoid making public the output of individual operators. There were altogether 5 deep productive mines and 3 placers, 2 of which are dredges. During 1910 the total yield of all these mines was 10,848.73 fine ounces of gold, valued at $224,263; 4,545 ounces of silver, valued at $2,454; and 298,898 pounds of copper, valued at $37,960, a total of $264,677, as compared with $244,183 in 1909. There was a decrease in the combined gold output of these counties, but an increase in yield of copper.

Monterey, San Luis Obispo, and Santa Cruz counties.—In these three adjoining coast counties there are altogether only 3 productive

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mines, 2 deep mines and 1 placer. Each county has only 1 productive mine. The combined output in 1910 was 49 fine ounces of gold, valued at $1,013, and 25 ounces of silver, valued at $13, a total value of $1,026. Neither San Luis Obispo nor Santa Cruz showed any production in 1909.

COLORADO.

By CHARLES W. HENDERSON.

PRODUCTION.

The total value of the production of gold, silver, copper, lead, and zinc in Colorado in 1910, as reported from 898 productive mines, 42 of which were placers, amounted to $33,673,879, as compared with $33,907,140 in 1909, a decrease for 1910 of $233,261. Of the total value for 1910, 61 per cent represented gold, which was valued at $20,507,058, a decrease of $1,482,278, as compared with the yield of 1909. There was a decrease of 393,035 fine ounces of silver. The production of copper, which is mainly incidental to the recovery of other metals, decreased appreciably, the tonnage of true copper ores being considerably less than in 1909, and the quantity of copper in the dry ores of Lake, San Juan, San Miguel, and Ouray counties also decreasing. The quantity of lead produced in 1910 was 76,071,273 pounds, an increase of 3,903,483 pounds, due to an increased tonnage of lead-zinc ores and concentrates, the tonnage of true lead ores falling off slightly. The quantity of zinc produced was 77,089,648 pounds, an increase of 25,879,388 pounds.

The output of ore sold or treated in 1910 from Colorado mines was 2,434,664 short tons, an increase of 214,923 tons, as compared with the output in 1909.

The output of siliceous or dry ores was 1,957,379 tons, an increase of 208,267 tons. The average value of siliceous or dry ores per ton in gold and silver was $11.65 in 1910, as compared with $13.41 in 1909, with $13.10 in 1908, with $14.49 in 1907, and with $14.90 in 1906.

The output of copper ores was 15,078 tons, a decrease of 45,595 tons. The production of lead ores was 133,323 tons, a decrease of 41,160 tons, and the output of zinc ores increased from 5,014 tons in 1909 to 82,251, an increase of 77,237 tons. There were only 2,219 tons of copper-lead ores produced in 1910, a decrease of 7,048 tons. The output of lead-zinc ores was 244,414 tons, an increase of 23,222 tons. The combined output of zinc and lead-zinc ores showed an increase of 100,459 tons.

The average value per ton of copper ores in gold and silver was $27.91; of lead ores, $6.07; of zinc ores, $0.36; of copper-lead ores, $47.48; and of lead-zinc ores, $2.20. The average total value per ton in gold and silver of all the ore mined in Colorado in 1910 was $10.15, as compared with $11.78 in 1909, with $14.16 in 1908, with $15.67 in 1907, with $16.47 in 1906, with $17.37 in 1905, and with $17.89 in 1904.

During 1910 there were treated at amalgamating, cyaniding, or chlorinating mills, with or without concentration equipment (including all the custom mills in the State), 1,455,983 tons of ore, and the bullion saved contained $12,979,428 in gold, an average per ton of

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$8.91, and 396,381 ounces of silver, valued at $214,046, an average per ton of 0.27 ounce, or $0.15, a total value in gold and silver of $13,193,474, and an average total value of $9.06 per ton, as compared with $10.72 in 1909 and with $11.04 in 1908.

From 1,455,983 tons treated at amalgamating, cyaniding, and chlorinating mills, and from 464,673 tons sent to concentrating and separating mills, a total to both classes of mills of 1,920,656 tons (78.9 per cent of the total tonnage treated, as compared with 75.6 per cent in 1909), were produced 237,342 tons of concentrates—ratio, 8.1 to 1—from which were recovered $2,525,333 in gold, an average value per ton of $10.64, and 2,192,315 ounces of silver, valued at $1,183,850, an average per ton of 9.24 ounces, or $4.99, a total value in gold and silver of $3,709,183, and an average value of $15.63 per ton, as compared with $22.68 per ton in 1909 and with $19.60 in 1908. From these concentrates were also recovered 2,419,045 pounds of copper, valued at $307,219, averaging 0.51 per cent, or $1.295 per ton; 46,560,748 pounds of lead, valued at $2,048,673, averaging 9.81 per cent, or $8.633 per ton; and 57,683,333 pounds of zinc (figured as spelter), valued at $3,114,900, or $13.124 per ton—a total average value for the concentrates in gold, silver, copper, lead, and zinc of $38.68 per ton. There were recovered from the 1,920,656 tons to both classes of mills $15,504,761 in gold, from both bullion and concentrates, or an average recovery per ton of $8.07, and silver valued at $1,397,896, or an average per ton of $0.73, a total value in gold and silver of $16,902,657, and an average per ton of $8.80 for all ore milled, as compared with $10.52 per ton in 1909 and with $10.82 in 1908. The copper recovered from the milling ore averaged $0.16 per ton; the lead, $1.07; and the zinc, $1.62, making a total value of all milling ore in gold, silver, copper, lead, and zinc of $22,373,449 and an average value per ton of $11.65.

There were 514,008 tons of crude ore shipped to all kinds of smelters, from which were recovered $4,335,591 in gold, averaging $8.435 per ton; 5,915,292 ounces of silver, valued at $3,194,258, averaging 11.51 ounces, or $6.214 per ton, a total value in gold and silver of $7,529,849, and an average of $14.649 per ton, as compared with $15.60 per ton in 1909 and with $14.86 in 1908. Crude ore also contained 5,940,262 pounds of copper, valued at $754,413, averaging 0.58 per cent, or $1.468 per ton; 29,498,027 pounds of lead, valued at $1,297,913, averaging 2.87 per cent, or $2.525 per ton; and 19,406,315 pounds of zinc valued at $1,047,941, averaging $2.039 per ton; a total value for crude ore shipped to smelters of $20.68 per ton, as compared with $22.83 per ton in 1909.

Crude ore and concentrates to smelters therefore amounted to 751,350 tons, from which were recovered $6,860,924 in gold, 8,107,607 fine ounces of silver, 8,359,307 pounds of copper, 76,058,775 pounds of lead, and 77,089,648 pounds of zinc, with a total value of $19,819,091. Therefore the smelters treated 30.8 per cent of the tonnage mined, and recovered 34.6 per cent of the gold, 95.3 per cent of the silver, and all the copper, lead, and zinc, and 60 per cent of the total value of deep-mine output (excluding tailings and slag).

In 1910 there were 42 productive placers in Colorado, which yielded $395,465 in gold and 4,954 ounces, or $2,675 in silver, a total of $398,140 in gold and silver, as compared with $461,508 in 1909 and with $186,058 in 1908.

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The statement of Colorado production for 1909 and 1910, showing increase or decrease, and value at each year's commercial price, is as follows:

Mine production of gold, silver, copper, lead, and zinc, in Colorado, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,063,734.13	$21,989,336	992,028.93	$20,507,058	− 71,705.20	−$1,482,278
Silver.....do....	8,902,633	4,629,369	8,509,598	4,595,183	− 393,035	− 34,186
Copper.....pounds..	10,992,046	1,419,866	8,359,535	1,061,661	− 2,632,511	− 358,205
Lead.....do....	72,167,790	3,103,215	76,071,273	3,347,136	+ 3,903,483	+ 243,921
Zinc.....do....	51,210,260	2,765,354	77,089,648	4,162,841	+25,879,388	+ 1,397,487
Total.....	.....	33,907,140	.....	33,673,879	.....	− *233,261

GOLD.

The total gold production for Colorado in 1910 was 992,028.93 fine ounces, valued at $20,507,058, as against 1,063,734.13 fine ounces, valued at $21,989,336, in 1909, a decrease of 71,705.20 fine ounces in quantity and of $1,482,278 in value.

The Cripple Creek district, with a decrease of $468,420, produced $11,002,253 in gold, which was 53.7 per cent of the Colorado gold output from all sources, and 54.7 per cent of the gold from deep mines. Most of the mines were operated with reduced forces, the operators preferring to wait until the mines were unwatered rather than to maintain an output at a heavy cost for pumping. Ouray County's gold production showed a decrease of $848,978, as compared with the heavy output of 1909, when the increase was $1,016,127, as compared with the yield in 1908.

Besides Ouray County, notable decreases in gold yield were recorded from Lake, Park, Gilpin, and Summit, with less marked decreases in Boulder, Clear Creek, Dolores, and Eagle counties. La Plata County showed an increase of $263,725, San Miguel of $209,742, and Gunnison of $125,479. Chaffee, Mineral, and San Juan counties also made appreciable increases.

Siliceous and dry ores, which made 80.4 per cent of all the tonnage mined, yielded 943,220.53 fine ounces of gold, valued at $19,498,099, or 95 per cent of all the gold production. A little more than 1 per cent came from lead ores, less than 1 per cent from copper ores, and 1.41 per cent from zinc and lead-zinc ores. Nearly 2 per cent came from placers.

The output of placer gold in 1910 was 19,130.62 fine ounces, valued at $395,465, a decrease of $63,027. Summit County, with 4 dredges and 5 small placers, produced over 88 per cent of the placer yield. Hydraulic mines in Chaffee and Park counties produced the greater part of the remainder. There was an increased yield from Routt County, and a dredge in Costilla County recovered a moderate quantity. There were small placer yields in Clear Creek, Douglas, Eagle, Gilpin, Lake, and San Juan counties.

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Source of gold product in Colorado in 1910, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	
Boulder		6,547.07	23.41	197.71				6,768.19
Chaffee	822.86	2,194.73	49.72	664.87		0.05		3,732.23
Clear Creek	177.93	21,418.75	2,949.16	525.07			206.19	25,277.10
Costilla	112.13							112.13
Custer		473.00		.61			2.35	475.96
Delta		5.32						5.32
Dolores		393.14	27.91	319.98			.41	741.44
Douglas	4.02							4.02
Eagle	24.19	454.13	527.74	9.43			205.06	1,220.55
Garfield		174.30						174.30
Gilpin	37.49	29,637.69	3,300.95	301.13				33,277.26
Gunnison		11,300.70	5.34	4.33			8.03	11,318.40
Hinsdale		26.86	218.96	47.40		12.51		305.73
Lake	168.44	49,346.41	463.62	7,714.67	584.14	7.64	400.44	58,685.36
La Plata		18,787.75		119.33				18,907.08
Mineral		238.45					5,623.68	5,862.13
Montezuma		423.96						423.96
Ouray		105,901.61	83.74	234.52		4.23		106,224.10
Park	621.42	10,773.57	1,148.95	294.74	7.16			12,845.84
Pitkin		29.44		1.81				31.25
Rio Grande		63.18						63.18
Routt	323.58							323.58
Saguache		35.62	8.16	5.80				49.58
San Juan	42.57	32,547.04	116.44	802.40		154.86	708.43	34,371.74
San Miguel		119,635.65	37.17	314.27			698.52	120,685.61
Summit	16,795.99	508.41		161.09		2.67	370.89	17,839.05
Teller		532,233.99						532,233.99
Unapportioned		69.76		.09				69.85
Total	19,130.62	943,220.53	8,961.27	11,719.25	591.30	181.96	8,224.00	992,028.93

SILVER.

The silver yield in 1910 was 8,509,598 fine ounces, valued at $4,595,183, as against 8,902,633 ounces in 1909, valued at $4,629,369, a decrease of 393,035 ounces in quantity and of $34,186 in value.

Lake County, which in 1909 made an increase of over 500,000 ounces, showed for 1910 a decrease of 101,627 ounces, but the output was 39 per cent of the State yield, as compared with 38 per cent in 1909. Increases of note were in Chaffee, La Plata, and Ouray Counties. The Pitkin County yield again fell off materially, and there was an appreciable decrease in the yield from San Miguel County. There were small decreases in all the other counties except Clear Creek, Gunnison, Park, Saguache, and Summit.

In the production of silver 7 counties, ranking in the order named, Lake, San Miguel, San Juan, Mineral, Pitkin, Clear Creek, and Ouray, furnished nearly 87 per cent of the total.

Siliceous or dry ores yielded 6,117,719 ounces, or 71.9 per cent, of the silver output; lead ores, 1,050,611 ounces, or 12.3 per cent; zinc and lead-zinc ores, 711,810 ounces, or 8.4 per cent; copper ores, 436,358 ounces, or 5.1 per cent; copper-lead ores, 188,146 ounces, or 2.2 per cent. A negligible per cent came from placers.

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Source of silver product in Colorado in 1910, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	
Boulder	.....	41,249	16	5,252	.....	.....	.....	46,517
Chaffee	157	154,868	6,150	20,637	.....	191	.....	182,003
Clear Creek	30	135,603	199,961	50,169	.....	.....	89,391	475,174
Costilla	9	.....	.....	.....	.....	.....	.....	9
Custer	.....	6,528	.....	940	.....	.....	299	7,767
Delta	.....	139	.....	.....	.....	.....	.....	139
Dolores	.....	32,845	5,669	47,250	.....	.....	2,545	88,309
Eagle	7	6,502	66,702	954	.....	.....	14,148	88,313
Garfield	.....	113	.....	.....	.....	.....	.....	113
Gilpin	6	116,041	10,749	5,839	.....	.....	.....	132,635
Gunnison	.....	38,231	1,151	2,280	.....	.....	7,527	49,189
Hinsdale	.....	11,555	38,775	3,983	.....	109	.....	54,422
Lake	61	2,583,249	78,263	261,389	32,214	250	366,589	3,322,015
La Plata	.....	141,448	.....	89	.....	.....	.....	141,537
Mineral	.....	722,142	.....	.....	.....	.....	51,580	773,722
Montezuma	.....	215	.....	.....	.....	.....	.....	215
Ouray	.....	329,642	18,180	65,987	.....	441	.....	414,250
Park	128	10,936	9,047	96,830	96	.....	.....	117,037
Pitkin	.....	183,360	.....	294,453	.....	.....	.....	477,813
Rio Grande	.....	61	.....	.....	.....	.....	.....	61
Routt	48	.....	.....	.....	.....	.....	.....	48
Saguache	.....	242	15	4,584	.....	.....	.....	4,841
San Juan	15	427,709	1,006	117,258	.....	186,409	49,853	782,250
San Miguel	.....	1,083,357	654	53,417	.....	.....	6,622	1,144,050
Summit	4,493	36,791	.....	19,274	.....	746	90,946	152,250
Teller	.....	54,263	.....	.....	.....	.....	.....	54,263
Unapportioned	.....	630	.....	26	.....	.....	.....	656
Total	4,954	6,117,719	436,358	1,050,611	32,310	188,146	679,500	8,509,598

COPPER.

The copper output in 1910 decreased in quantity from 10,992,046 pounds to 8,359,535 pounds, and in value from $1,419,866 to $1,061,661. Copper production was reported from 23 counties in 1910.

As usual, Lake County was the leading copper producer, yielding 43.6 per cent of the State output in 1910; San Juan was second, with 14.5 per cent of the total; Ouray, Clear Creek, San Miguel, Gilpin, and Hinsdale, Chaffee, and Eagle followed in order. These 9 counties produced 8,049,912 pounds, or 96 per cent of the total.

Siliceous or dry ores yielded 6,044,125 pounds, or 72 per cent of the copper output; copper ores, 1,489,664 pounds, or 18 per cent; lead ores, 434,630 pounds, or 5 per cent; lead-zinc ores yielded 221,357 pounds, or nearly 3 per cent. The remainder came from copper-lead and zinc ores.

Source of copper product in Colorado in 1910, by kinds of ore, by counties, in pounds.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Boulder	14,578	833	1,361	.....	.....	.....	16,772
Chaffee	22,701	181,891	14,235	.....	7,945	.....	226,772
Clear Creek	346,254	241,490	7,804	.....	.....	247	595,795
Custer	1,526	.....	13	.....	.....	2,343	3,882
Dolores	383	1,299	95,381	.....	.....	.....	97,063
Eagle	329	207,739	1,483	.....	.....	.....	209,551
Garfield	425	.....	.....	.....	.....	.....	425
Gilpin	404,581	129,663	.....	.....	.....	.....	534,244
Grand	.....	56	.....	.....	.....	.....	56
Gunnison	16,976	737	203	.....	.....	3,108	21,024
Hinsdale	1,371	448,507	13,426	.....	2,168	.....	465,472
Lake	3,310,282	126,503	143,913	21,411	18,915	24,133	3,645,157
La Plata	110	.....	32	.....	.....	.....	142

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Source of copper product in Colorado in 1910, by kinds of ore, by counties, in pounds—Continued.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Mineral	11,357	.....	.....	.....	.....	17,674	29,031
Montezuma	220	.....	.....	.....	.....	.....	220
Ouray	462,084	108,603	43,983	.....	5,566	.....	620,236
Park	33,068	28,403	26,958	299	.....	.....	88,748
Pitkin	99	.....	24,744	.....	.....	.....	24,843
Rio Grande	87	.....	.....	.....	.....	.....	87
Saguache	288	268	4,806	.....	.....	.....	5,362
San Juan	907,404	11,479	45,816	.....	109,444	134,353	1,208,496
San Miguel	494,030	2,193	9,963	.....	.....	38,003	544,189
Summit	5,952	.....	281	.....	4,011	1,496	21,740
Unapportioned	.....	.....	228	.....	.....	.....	228
Total	6,044,125	1,489,664	434,630	21,710	148,049	221,357	8,359,535

LEAD.

The lead production in Colorado in 1910 was 76,071,273 pounds, valued at $3,347,136, as against 72,167,790 pounds, valued at $3,103,215 in 1909, an increase of 3,903,483 pounds in quantity and of $243,921 in value.

There were marked increases in output from San Miguel, San Juan, Summit, and Ouray counties, and also material increases from Chaffee, Eagle, Gunnison, Hinsdale, and Pitkin counties. Decreases of particular note were from Lake, Clear Creek, and Mineral counties; less noticeable decreases were from Boulder, Dolores, and Gilpin counties.

In rank, Lake County led, with 19,249,503 pounds; Pitkin was second, with 13,408,250 pounds; San Juan was third, with 10,688,386 pounds; Mineral was fourth, with 8,246,000 pounds; San Miguel was fifth, with 7,791,841 pounds; and Summit, Ouray, Clear Creek, Park, and Chaffee followed in order. There was a decrease of 41,160 tons in the tonnage of lead ores produced, but an increase of 23,222 tons in that of lead-zinc ores. Siliceous or dry ores yielded 25,898,094 pounds, or 34 per cent of the lead output; lead ores, 23,914,921 pounds, or 31.4 per cent; lead-zinc ores, 23,605,329 pounds, or 31 per cent; zinc ores, 1,733,700 pounds, or 2.3 per cent; copper and copper-lead ores combined, 1.2 per cent.

Source of lead product in Colorado in 1910, by kinds of ore, by counties, in pounds.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Boulder	9,108	.....	44,142	.....	.....	.....	53,250
Chaffee	591,819	4,724	363,308	.....	2,819	7,853	970,523
Clear Creek	489,656	.....	815,271	.....	.....	1,129,549	2,434,476
Custer	2,042	.....	5,258	.....	.....	7,196	14,796
Dolores	3,339	52	46,913	.....	.....	77,605	127,909
Eagle	14,249	1,034	15,044	.....	.....	367,082	397,409
Gilpin	455,423	18,603	101,451	.....	.....	.....	575,477
Gunnison	385,263	.....	44,867	.....	.....	151,711	581,841
Hinsdale	4,554	83,267	203,459	.....	4,902	.....	296,182
Lake	4,693,107	3,739	4,969,667	1,731,927	22,418	7,828,645	19,249,503
La Plata	.....	.....	273	.....	.....	.....	273
Mineral	1,057,703	.....	.....	.....	.....	7,188,297	8,246,000
Ouray	3,353,110	24,932	617,736	.....	8,950	.....	4,004,728
Park	293,451	.....	1,745,980	1,773	.....	.....	2,041,204
Pitkin	682,274	.....	12,725,976	.....	.....	.....	13,408,250
Rio Grande	250	.....	.....	.....	.....	.....	250
Saguache	244	24	160,800	.....	.....	.....	161,068
San Juan	6,738,792	8,091	1,348,856	.....	724,025	1,868,622	10,688,386
San Miguel	6,908,377	330	495,389	.....	.....	387,745	7,791,841
Summit	204,069	.....	209,297	.....	11,319	4,590,724	5,015,409
Unapportioned	11,264	.....	1,234	.....	.....	.....	12,498
Total	25,898,094	144,796	23,914,921	1,733,700	774,433	23,605,329	76,071,273

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ZINC.

In 1910 the marketed zinc ores from Colorado contained 77,089,648 pounds of zinc (figured as spelter), valued at $4,162,841, as compared with 51,210,260 pounds, valued at $2,765,354 in 1909, an increase of 25,879,388 pounds in quantity and of $1,397,487 in value.

Lead-zinc ores yielded 45,605,941 pounds, or 59 per cent of the total zinc yield; zinc ores, 26,987,488 pounds, or 35 per cent; and siliceous or dry ores, 4,496,219 pounds, or a little less than 6 per cent.

In Lake County, which produced 73 per cent of the State zinc output, the zinc yield increased from 38,637,315 pounds to 56,367,445 pounds, an increase of 17,730,130 pounds. There was an increase in output of both lead-zinc and zinc ores from this county in 1910. The shipments at the end of the year of the newly discovered zinc carbonates added slightly to the zinc output for the year. The further verification of the existence of large deposits of these smithsonite and calamine ore bodies promises a material quantity of zinc from this class of ore, as well as from the zinc sulphides, and the mining of these zinc carbonate ore bodies indicates the discovery of new lead deposits, the extent and output of which at present development are very low.

Material increases in zinc yield were also made from Eagle, San Juan, San Miguel, Mineral, Clear Creek, and Park counties. A comparatively small decrease was noted from Summit County, which is the second county in rank in the output of zinc, followed closely in 1910 by Eagle County. The only material decrease was from Chaffee County, where the yield was less than one-half that of 1909.

The average assay of the crude zinc ore of Leadville milled was 24.16 per cent, and the average assay of zinc ore shipped direct to smelters was 29.52 per cent. Some zinc middlings with as low as 15 per cent of zinc were marketed in 1910. At present zinc carbonates find a market only if assaying above 30 per cent or more. Mining companies of Leadville report much zinc carbonate developed, assaying 22 per cent, which is not marketable at present. No zinc carbonates were concentrated in 1910, nor is there any record of concentration being applied to this class of ore. Mineral County zinc concentrate averaged 41.2 per cent, concentrated from crude ore assaying 4 to 6 per cent, but these ores carry free-milling gold, as well as appreciable quantities of silver and lead. The ore of the Robinson mine, of Summit County, assays lead 10.4 per cent; zinc 14.8 per cent; and silver 7 ounces, and gold 0.07 ounce per ton. In San Juan and San Miguel counties zinc is yielded as an additional saving from precious metal-bearing sulphides. No figures for publication are at hand for the tenor of ore treated in other counties. The crude zinc ore of upper Clear Creek County is usually sold on a lead basis, unless the zinc tenor is above 36 per cent. The zinc industry of Colorado was not of appreciable moment until 1902. In 1910 the quantity of zinc yielded was 1,018,375 more pounds than that of lead and the value was $815,705 more than the value of lead.

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Zinc production[a] in Colorado, since the first tonnage of any quantity was shipped,[b] 1902–1910, in pounds.

Year.	Quantity.	Average price per pound.	Value.
1902	52,582,510	$0.048	$2,523,960
1903	80,616,000	.054	4,353,264
1904	64,976,235	.051	3,313,788
1905	81,198,944	.059	4,700,738
1906	85,488,901	.061	5,214,823
1907	85,018,157	.059	5,016,071
1908	30,130,002	.047	1,416,110
1909	51,210,260	.054	2,765,354
1910	77,089,648	.054	4,162,841
Total and average	608,310,657	.055	33,556,949

[a] Estimated recovery from zinc ores. 1902–1908, estimated by Bureau of Mines, Colorado, from smelting companies; 1908–1910, United States Geological Survey figures as calculated from reports from the mines and smelting companies.

[b] Some small tonnages were shipped prior to 1902. See history of the zinc industry in Colorado: Min. Science, July 27, 1911, p. 85.

Source of zinc product in Colorado in 1910, by kinds of ore, by counties, in pounds.

County.	Siliceous or dry ores.	Zinc ores.	Lead-zinc ores.	Total.
Boulder	7			
Chaffee		413,500	25,039	438,539
Clear Creek		180,000	1,067,389	1,247,389
Custer			6,796	6,796
Delta				
Dolores			87,000	87,000
Eagle			4,147,945	4,147,945
Fremont		18,072		18,072
Gunnison			176,815	176,815
Lake		24,882,016	31,485,429	56,367,445
Mineral			2,421,926	2,421,926
Park		659,796		659,796
San Juan	2,552,487		1,228,772	3,781,259
San Miguel	1,943,732		250,249	2,193,981
Summit		834,104	4,708,581	5,542,685
Total	4,496,219	26,987,488	45,605,941	77,089,648

MINING INDUSTRY OF COLORADO IN 1910.

A comparison of the production of metals in Colorado in 1909 and 1910, as reported from the mines to the United States Geological Survey, shows in 1910 an important decrease in the output of gold, an appreciable decrease in the output of silver and copper, an appreciable increase in the yield of lead, and a heavy increase in the yield of zinc. From 1908 to 1910 the trend of decrease and increase was along the same lines, with the exception of copper (generally a by-product in the mining of other metals), the output of which for the last two years shows a decrease, there being an increase in 1909 which was offset by a decrease of larger quantity in 1910.

A review of the sources of the metals for the years 1909–1910 shows that in 1910 there was less gold and silver produced from placers and, despite a larger tonnage treated at amalgamating, cyaniding, and chlorination mills, less gold-silver bullion produced; that despite a larger tonnage to mills with concentration equipment, and a larger tonnage of concentrates produced, there was recovered from the concentrates only a slightly increased quantity of gold, less silver,

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and copper, but decidedly more lead and zinc; that there was a smaller tonnage of ore sent to all kinds of smelters, and the contents contained less in gold, silver, copper, lead, and zinc. That is, there was less bullion produced, more lead and zinc concentrates, and less ore suitable for direct smelting. There was more gold and silver bearing siliceous ore mined, but the contents in gold and silver averaged $1.76 less per ton. The tonnages of lead, copper, and copper-lead ores, which in Colorado are small but which carry comparatively high contents in gold and silver, again decreased, representing, in 1910, 6 per cent of the tonnage. The combined tonnage of zinc and lead-zinc ores increased 100,459 tons, making a total for 1910 of 326,665 tons, or 13 per cent of the total.

From a metallurgical standpoint, it was found that 79 per cent (as compared with 76 per cent in 1909) of the tonnage was milled; that 12 per cent of this tonnage, or 10 per cent of the total tonnage, was the resulting tonnage in concentrates, which were treated at smelters; and that 21 per cent (as compared with 24 per cent in 1909) was sent crude direct to smelters, a total percentage treated by the smelters of 31 per cent (the same as in 1909) of the total tonnage. It is found, therefore, that smelters treating the same percentage of a larger tonnage treated an increased tonnage in 1910, and recovered 34.6 per cent of the gold, 95.3 per cent of the silver, and all the copper, lead, and zinc, or 60 per cent of the total value of the metals from deep mines.

The situation as regards smelters in Colorado remained about the same as it was at the close of 1909. The furnaces of the Boston & Colorado Smelting Co.'s. plant at Argo were "out" on March 17, 1910. This plant had been established in Black Hawk, Gilpin County, in 1872, and had been moved to Denver in 1873. The Modern Co.'s plant at Utah Junction started operations October 22, 1909, and closed early in 1910. The North American Co.'s semipyritic plant at Golden started April 9, 1910, and ran almost continuously on ore from its own and other mines in Clear Creek County and other counties in the State. A new semipyritic 150-ton smelter, at Alma, was operated for a short time. The United States Smelting Co.'s zinc-oxide plant at Canon City closed in October, 1909, and was not reopened. An increased tonnage of zinc-copper-lead ore was treated at the plant of the United States Zinc Co., at Blende. The other lead and copper plants of the State treated a slightly smaller tonnage of Colorado ores and concentrates.

The following list gives the smelting plants in Colorado in 1910:

List of active smelting plants in Colorado in 1910.

City.	Plant.	Owner.
Denver	Globe	American Smelting & Refining Co.
Pueblo	Pueblo	Do.
Pueblo [a]	United States Zinc Co.	Do.
Leadville	Arkansas Valley	Do.
Durango	Durango	Do.
Salida		Ohio & Colorado Smelting & Refining Co.
Denver [b]	Argo	Boston & Colorado Smelting & Refining Co.
Utah Junction [c]	Modern	Modern Smelting & Refining Co.
Golden [d]		North American Smelter & Mines Co.

[a] Zinc-copper ores. [b] Closed March, 1910. [c] Closed April, 1910. [d] Started Apr. 6, 1910.

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As regards the metallurgical processes used in the mills of this State, 59.8 per cent of the ore was treated at amalgamating, cyaniding, or chlorination mills, with or without concentration equipment, and 19.1 per cent was treated at mills for concentration only (a total of 78.9 per cent of the total tonnage, equaling 1,920,656 tons, or representing in a 365-day year a daily tonnage treated of 5,262 tons per day). Of the Cripple Creek tonnage, which represents 27 per cent of the total tonnage sold or treated, 95 per cent was treated at local cyanide plants at Cripple Creek and at the chlorination, concentration, and cyanide plants at Colorado City, and represents in a 365-day year a daily tonnage treated of 1,744 tons. The Golden Cycle plant has a capacity of about 1,000 tons per day; and the Portland chlorination mill is a 350-ton plant and the Portland cyanide is a 500-ton plant, both at Colorado Springs. The Standard and Colorado plants of the United States Reduction & Refining Co. have a smaller capacity. The Portland mill at Victor, operated almost continuously since July, 1910, is a 300-ton plant. The Stratton's Independence plant at Victor reached a capacity of 300 tons per day in November. Of the tonnage from Leadville, representing 19 per cent of the total tonnage sold or treated, 30 per cent was milled in the State, representing a daily tonnage of 377 tons. Of the tonnage of Ouray, San Juan, and San Miguel counties, together representing 33 per cent of the total tonnage, 98.5 per cent was milled, representing a daily tonnage of 2,154 tons. Clear Creek and Gilpin counties represented a daily tonnage treated of 426 tons per day.

Smelters in the State and the zinc plants outside the State treated 751,350 tons of crude ore and concentrates, or a daily tonnage in a 365-day year of 2,058 tons of Colorado ore. The total tonnage of ore and concentrates from other States and Colorado combined treated at all smelting plants (excluding the United States Zinc Co.) was about 900,000 tons, representing a total daily capacity of about 2,500 tons.

There continued much leasing in every district in the State. The system followed at Cripple Creek and Leadville is somewhat peculiar to those districts. Lessees and the owning companies often work different parts of the same mine. In Cripple Creek the El Paso Co. leased its upper four levels, but continued development work on the lower levels, sunk a new shaft, and unwatered the mine. This company operates the mine plant, charges the lessees for power and air, and sells the supplies to the lessees. The Elkton Co. leased part of its mine. The Stratton's Independence mine was leased, while the company operated the mill on dump ore. The United Gold Mines Co. leased its mines and mills, doing a little development on company account. The Mary McKinney and Granite mines were leased until the water is lowered far enough to permit the companies to continue work at lower depths. Some lessees at Cripple Creek are incorporated companies, operating several different mines. At Leadville the Yak Tunnel Co. continued to drive the tunnel and laterals and operated several of the mines itself or under the name of subsidiary companies and leased other mines, the company furnishing haulage and power. In the Clear Creek-Gilpin area the Newhouse Tunnel Co. makes a charge for haulage and furnishes compressed air and electricity and does blacksmithing for the lessees.

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Cripple Creek district, despite a large tonnage of dump ore treated at Cripple Creek and a considerable tonnage of old tailings treated at Colorado Springs mills, showed a decrease of $468,420 in gold production as compared with the yield in 1909, and a decrease of $1,738,034 as compared with that of 1908. Conditions during the year in this district were as in 1909, several of the large companies working a reduced force and awaiting for the completion of the Roosevelt drainage tunnel. The Stratton's Independence mill was operated at an increasing capacity on dump ore and the new Portland mill, at Victor, from July ran almost continuously on rock taken out in development work, supplemented by ore from the dump. Most of the smaller local cyanide mills were inactive during the year, the result being a reduced output from this source. The drainage tunnel was completed as far as the original plans outlined, a distance of 15,640 feet, in December, and the lowering of water was noticed in many of the mines. The El Paso mine was connected with the tunnel by crosscut, raise, and churn-drill hole, and the water was gradually subsiding at the end of the year. Since the end of the year a crosscut was run to cut the C. K. and N. vein, and the total length of the tunnel in February, 1911, was 15,746 feet from the portal. The United States Reduction & Refining Co. lowered its rates in September for the treatment of the higher grade ores of Cripple Creek, this being the second reduction during the year. The Golden Cycle plant did not meet the cut, but the Portland mill reduced its rates for a time but again restored its former rates. The minimum charge of $4 on one-half ounce ore remained the same. The Stratton's Independence mill to date has treated $3 to $4 dump rock at a cost of $1.50 per ton, not including depreciation and amortization.[1] No official statement as to the grade of rock treated and costs have been made by the Portland Co., except that much of the ore treated was taken out in development drifts, having been hitherto thrown on the dump and of too low a content to come within the one-half ounce schedule

At Leadville an increased tonnage was shipped, sold, treated, or removed for treatment. Most of the ore came from the mines on or closely adjoining Breece and Iron hills and was either siliceous or mixed sulphide ores. Oxidized lead and iron-oxide ores, chiefly from Fryer and Carbonate hills, showed a decrease in output, but the tonnage of the newly discovered zinc carbonates came chiefly from the mines on these hills, beside a considerable tonnage of zinc sulphide ore from Carbonate Hill mines. The Coronado and the Hibschle mines were the only mines operated in the Downtown district proper.[2] Of the tonnage of Leadville ores, 4 per cent was true lead oxide ore, 4.6 was siliceous ore, 17.9 per cent iron-manganese fluxing ore (carrying a little lead and silver), 1.8 per cent zinc-carbonate ore, and 71.7 per cent mixed sulphide ores. The breast of the Yak tunnel passed the Resurrection No. 2 shaft and entered the territory of the Diamond mine, the shaft of which marks 3.46 miles from the portal. The Resurrection No. 2 mine was drained and the shaft sunk below the level of the tunnel.

The San Juan district showed a reduced yield in gold. Although La Plata County made a comparatively heavy increase in the output

[1] Argall, Philip Henry, Reduction of cyanide costs at Cripple Creek: Min. Science, Dec. 15, 1910, p. 567.
[2] The Downtown district of Leadville, Colo.; Bull. U. S. Geol. Survey No. 320, 1907.

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of gold and San Juan and San Miguel counties yielded small increases in gold, the decrease of $848,978 (as compared with yield of 1909, which was above the average) in Ouray County made a total decrease in the yield of that metal for this region. Silver and copper production decreased, but there was a notable increase in the yield of lead and a marked increase in the output of zinc from the combined yields of Dolores, La Plata, Ouray, San Juan, and San Miguel counties of the San Juan district. The Camp Bird mine, in the Sneffels district, Ouray County, produced a tonnage equal to that of 1909, but the gold-bullion output was less, though the tonnage in concentrates increased. San Juan County mills were more active than in 1909, and there was more gold-silver bullion produced, as well as a greatly increased yield of lead and lead-zinc concentrates. An increased tonnage was mined and milled from the mines near Ophir and Telluride, San Miguel County. The Liberty Bell, Smuggler-Union, and Tomboy mines at Telluride, which yield 90 per cent and more of the yield of this county, all produced larger tonnages in 1910. La Plata County yielded a decided increase of gold-bearing ores, and the amount of development done promises an increased yield for 1911. Dolores County production again showed a decrease.

Hinsdale County also belongs to the San Juan group of counties. The yield of this county is chiefly copper, for which there was a decrease in 1910. Mineral County (Creede) is also in the San Juan,[1] but is usually considered alone. The ores are chiefly lead-zinc, or dry, carrying lead and zinc. There was an increased tonnage milled in 1910, with the chief increase in zinc recovery.

The mines of lower Clear Creek County and the Russell district in Gilpin County produced a slightly increased tonnage, but there was a slight decrease in tonnage from the upper Clear Creek mines. Gilpin County output, as a whole, shows a decided decrease. The Newhouse tunnel, from a point below Idaho Springs, Clear Creek County, under Russell Gulch and Quartz Hill, Gilpin County, was completed in November, 1910, when it reached a point under the Gunnell mines near Central City, the total length being 21,968 feet. The Central tunnel, starting above Idaho Springs, and the Lucania tunnel, also starting above Idaho Springs, near Fall River, were driven some distance during the year, in a general direction toward Central City. Operation of the Malm dry-chlorination mill at Georgetown was not begun in 1910.

Boulder County mines yielded a small increase in tonnage, but the total value of the output decreased. An increased tonnage was shipped to smelters from Chaffee County, with increase in the yield of gold, silver, and lead and decrease in the output of copper and zinc. The placer yield from Granite, Chaffee County, fell off slightly. Costilla County entered the producing list from operations of a dredge, near Russell. The yield from Custer County, which has been very small in recent years, fell off slightly. The total value of ore mined in Eagle County increased in value, the increase being almost entirely in zinc. A larger tonnage was treated in the mills of Gunnison County, with increases in output of gold, silver, and lead and small decreases in copper and zinc. A new smelter at Alma stimulated the output from the Consolidated Montgomery district in Park County,

[1] Cross, Whitman, Silverton folio (No. 120), Geol. Atlas U. S., U. S. Geol. Survey, 1905, p. 1.

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but there was a material decrease in the tonnage shipped from the Mosquito district, the tonnage of which only represented 50 per cent of the county total, as compared with 75 per cent in 1909. Pitkin County (Aspen) still remained the second county in production of lead, the yield of which increased, the output of all other metals decreasing. There was no output from deep mines of Routt County, but the placer yield made an increase in the total value for 1910. Saguache County yielded a larger tonnage than in 1909. Summit County, at present the principal dredging field in Colorado and the second county in importance of zinc output, yielded less gold from both deep mines and dredges. The output of lead and zinc from this county was also less than in 1909.

The dredges near Breckenridge, Summit County, yielded only about 16,500 fine ounces of gold in 1910, as compared with 20,000 ounces in 1909. There were 4 dredges in operation in 1910, but 1 was not operated steadily. The Colorado Gold Dredging Co. had 1 dredge in Blue River and 1 in Swan River. The French Gulch Dredging Co. operated in French Gulch on the Mecca placer, and the Reliance Gold Dredging Co. also operated in French Gulch.

A dredge built in 1910 at Russell, Costilla County, operated for a time during the year.

There was a small output of placer gold from dredging ground at Lay, Routt County.

The following table shows the production of gold, silver, copper, lead, and zinc in Colorado, by counties:

Mine production of gold, silver, copper, lead, and zinc in 1910 in Colorado, by counties.

County.	Producing mines.	Tonnage of deep mines.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Boulder	85	14,083	6,768.19	$139,911	46,517	$25,119
Chaffee	26	12,496	3,732.23	77,152	182,008	98,282
Clear Creek	157	109,954	25,277.10	522,524	475,174	256,594
Costilla	1	.....	112.13	2,318	9	5
Custer	9	7,052	475.96	9,839	7,767	4,194
Delta	1	2	5.32	110	139	75
Dolores	13	2,933	741.44	15,327	88,309	47,687
Douglas	1	.....	4.02	83	.....	.....
Eagle	13	27,761	1,220.55	25,231	88,313	47,689
Fremont	1	29	.....	.....	.....	.....
Garfield	1	92	174.30	3,603	113	61
Gilpin	162	83,631	33,277.26	687,902	132,635	71,623
Grand	1	1	.....	.....	.....	.....
Gunnison	14	25,203	11,318.40	233,972	49,189	26,562
Hinsdale	12	3,468	305.73	6,320	54,422	29,388
Lake	105	462,033	58,685.36	1,213,134	3,322,015	1,793,888
La Plata	8	6,350	18,907.08	390,844	141,537	76,430
Mineral	9	62,956	5,862.13	121,181	773,722	417,810
Montezuma	2	448	423.96	8,764	215	116
Ouray	24	111,245	106,224.10	2,195,847	414,250	223,695
Park	17	12,329	12,845.84	265,547	117,037	63,200
Pitkin	12	89,037	31.25	646	477,813	258,019
Rio Grande	1	12	63.18	1,306	61	33
Routt	6	.....	323.58	6,689	48	26
Saguache	8	296	49.58	1,025	4,841	2,614
San Juan	54	206,272	34,371.74	710,527	782,250	422,415
San Miguel	43	481,000	120,685.61	2,494,793	1,144,050	617,787
Summit	29	47,040	17,839.05	368,766	152,250	82,215
Teller	83	668,941	532,233.99	11,002,253	54,263	29,302
Unapportioned	.....	.....	69.85	1,444	656	354
Total	898	2,434,664	992,028.93	20,507,058	8,509,598	4,595,183

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Mine production of gold, silver, copper, lead, and zinc in 1910 in Colorado, by counties—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	16,772	$2,130	53,250	$2,343			$169,503
Chaffee	226,772	28,800	970,523	42,703	438,539	$23,681	270,618
Clear Creek	595,795	75,666	2,434,476	107,117	1,247,389	67,359	1,029,260
Costilla							2,323
Custer	3,882	493	14,796	651	6,796	367	15,544
Delta							185
Dolores	97,063	12,327	127,909	5,628	87,000	4,698	85,667
Douglas							83
Eagle	209,551	26,613	397,409	17,486	4,147,945	223,989	341,008
Fremont					18,072	976	976
Garfield	425	54					3,718
Gilpin	534,244	67,849	575,477	25,321			852,695
Grand	56	7					7
Gunnison	21,024	2,670	581,841	25,601	176,815	9,548	298,353
Hinsdale	465,472	59,115	296,182	13,032			107,855
Lake	3,645,157	462,935	19,249,503	846,978	56,367,445	3,043,842	7,360,777
La Plata	142	18	273	12			467,304
Mineral	29,031	3,687	8,246,000	362,824	2,421,926	130,784	1,036,286
Montezuma	220	28					8,908
Ouray	620,236	78,770	4,004,728	176,208			2,674,520
Park	88,748	11,271	2,041,204	89,813	659,796	35,629	465,460
Pitkin	24,843	3,155	13,406,250	589,963			851,783
Rio Grande	87	11	250	11			1,361
Routt							6,715
Saguache	5,362	681	161,068	7,087			11,407
San Juan	1,208,496	153,479	10,688,386	470,289	3,781,259	204,188	1,960,898
San Miguel	544,189	69,112	7,791,841	342,841	2,193,981	118,475	3,643,008
Summit	21,740	2,761	5,015,409	220,678	5,542,685	299,305	973,725
Teller							11,031,555
Unapportioned	228	29	12,498	550			2,377
Total	8,359,535	1,061,661	76,071,273	3,347,136	77,089,648	4,162,841	33,673,879

Subdivision of crude ore sold or treated in Colorado in 1910, by counties, in short tons.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Boulder	13,863	13	207				14,083
Chaffee	7,211	2,096	2,254	863	16	56	12,496
Clear Creek	79,313	2,450	3,092	225		24,874	109,954
Custer	6,891		37			124	7,052
Delta	2						2
Dolores	2,046	17	701			169	2,933
Eagle	806	4,200	142			22,613	27,761
Fremont				29			29
Garfield	92						92
Gilpin	82,291	1,096	244				83,631
Grand		1					1
Gunnison	24,582	10	205			406	25,203
Hinsdale	159	1,056	2,219		34		3,468
Lake	254,723	2,032	33,911	78,675	90	92,602	462,033
La Plata	6,349		1				6,350
Mineral	25,791					37,165	62,956
Montezuma	448						448
Ouray	107,260	1,374	2,553		58		111,245
Park	4,421	549	6,242	1,117			12,329
Pitkin	11,739		77,298				89,037
Rio Grande	12						12
Saguache	9	3	284				296
San Juan	178,565	157	2,436		1,999	23,115	206,272
San Miguel	471,849	24	1,123			8,004	481,000
Summit	10,016		374	1,342	22	35,286	47,040
Teller	668,941						668,941
Total, 1910	1,957,379	15,078	133,323	82,251	2,219	244,414	2,434,664
Total, 1909	1,749,112	60,673	174,483	5,014	9,267	221,192	2,219,741
Increase (+) or decrease (−)	+208,267	−45,595	−41,160	+77,237	−7,048	+23,222	+214,923
Average recovered value in gold and silver per ton	$11.65	$27.91	$6.07	$0.36	$47.48	$2.20	$10.15

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Tonnage of ore sold or treated, number of deep mines producing, and average value per ton of ore from deep mines in Colorado in 1909 and 1910.

County.	Total ore sold or treated.			Number of deep mines producing.		Average total value per ton.	
	1909	1910	Increase (+) or decrease (−).	1909	1910	1909	1910
	Short tons.	*Short tons.*	*Short tons.*				
Boulder	13,188	14,083	+ 895	56	85	$15.83	$12.04
Chaffee	10,214	12,496	+ 2,282	26	23	17.59	20.29
Clear Creek	116,753	109,954	− 6,799	146	147	8.44	9.33
Custer	5,871	7,052	+ 1,181	9	9	4.63	2.20
Delta	.....	2	+ 2	.....	1	.....	92.50
Dolores	4,787	2,933	− 1,854	10	13	23.14	29.21
Eagle	11,526	27,761	+ 16,235	14	12	17.45	12.27
Fremont, Jefferson, Grand, and Montezuma	6	.....	− 6	3	.....	46.40	.....
Fremont	.....	29	+ 29	.....	1	.....	33.66
Garfield	.....	92	+ 92	.....	1	.....	40.41
Gilpin	111,118	83,631	− 27,487	244	157	9.63	10.19
Grand	.....	1	+ 1	.....	1	.....	7.00
Gunnison	9,071	25,203	+ 16,132	18	14	18.45	11.84
Hinsdale	1,697	3,468	+ 1,771	10	12	85.11	31.10
Lake	417,297	462,033	+ 44,736	96	104	16.49	15.92
La Plata	4,135	6,350	+ 2,215	10	8	40.11	73.59
Larimer	48	.....	− 48	1	.....	34.56	.....
Mineral	64,941	62,956	− 1,985	7	9	16.34	16.46
Montezuma	.....	448	+ 448	.....	2	.....	19.88
Ouray	103,864	111,245	+ 7,381	30	24	33.45	24.0
Park	15,046	12,329	− 2,717	14	13	46.83	36.71
Pitkin	112,448	89,037	− 23,411	12	12	8.32	9.57
Rio Grande	.....	12	+ 12	.....	1	.....	113.42
Routt	24	.....	− 24	1	.....	113.33	.....
Saguache	192	296	+ 104	8	8	33.59	38.54
San Juan	187,041	206,272	+ 19,231	40	53	9.32	9.50
San Miguel	423,609	481,000	+ 57,391	39	43	7.80	7.57
Summit	31,098	47,040	+ 15,942	27	20	18.11	13.27
Teller	575,670	668,941	+ 93,271	83	83	19.83	16.49
Unapportioned	97	.....	− 97	.....	.....	26.36	.....
Total	2,219,741	2,434,664	+214,923	904	856	.....	.....
Average value per ton	.....	.....	.....	$15.07	$13.67	.....	.....

Tonnage of ore to gold and silver mills and concentrating mills, with quantity of gold and silver contained in bullion produced in Colorado in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Boulder	7,498	1,452.14	682	373
Clear Creek	47,248	2,833.83	1,293	41,569
Custer	6,800	467.98	4,100	124
Dolores	.....	.....	.....	1,960
Eagle	.....	.....	.....	22,613
Gilpin	47,211	5,576.14	1,275	19,575
Gunnison	23,468	4,891.19	2,991	1,204
Hinsdale	.....	.....	.....	2,213
Lake	.....	3,920.90	1,307	137,772
La Plata	.....	115.18	41	300
Mineral	.....	.....	.....	37,165
Montezuma	.....	.....	.....	128
Ouray	102,971	76,122.77	47,593	3,535
Park	237	105.77	31	.....
Pitkin	.....	.....	.....	55,856
San Juan	131,593	13,953.69	5,752	68,627
San Miguel	452,240	87,222.11	304,722	27,364
Summit	85	165.89	79	44,295
Teller	636,632	431,052.24	26,515	.....
Total	1,455,983	627,879.83	396,381	464,673

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Tonnage of ore to gold and silver mills and concentrating mills, with quantity of gold and silver contained in bullion produced in Colorado in 1910, by counties—Continued.

County.	Concentrates produced.					
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	202	473.92	1,061	1 253	37	.....
Clear Creek	8,115	5,854.13	176,444	131,572	1,462,977	962,588
Custer	31	2.35	299	2,343	7,496	6,796
Dolores	95	266.39	16,688	75	1,053	.....
Eagle	6,817	205.06	14,148	.....	367,082	4,147,945
Gilpin	9,066	6,548.20	47,449	195.060	328,131	.....
Gunnison	2,700	6,390.60	31,259	16,948	397,292	.....
Hinsdale	245	47.06	3,733	13,395	202,777	.....
Lake	86,577	873.38	276,594	20,920	6,825,502	39,498,175
La Plata	10	9.38	147	.....	.....	.....
Mineral	8,752	5,623.68	51,580	17,674	7,188,297	2,421,926
Montezuma	64	70.52	26	97	.....	.....
Ouray	12,268	28,718.57	188,269	452,668	3,231,405	.....
Pitkin	13,955	1.35	111,128	24,516	5,908,475	.....
San Juan	32,713	18,645.22	370,265	997,273	8,571,423	3,743,341
San Miguel	32,251	33,032.90	781,995	529,633	7,292,248	2,193,981
Summit	17,205	531.53	119,362	15,618	4,776,553	4,708,581
Teller	6,276	14,868.75	1,868	.....	.....	.....
Total	237,342	122,162.99	2,192,315	2,419,045	46,560,748	57,683,333

Mine production of gold, silver, copper, lead, and zinc from Colorado crude ore shipped to smelters in 1910, by counties.

County.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	6,212	4,842.13	44,774	15,519	53,213	.....
Chaffee	12,496	2,909.37	181,846	226,772	970,523	438,539
Clear Creek	21,137	16,411.21	297,407	464,223	971,499	284,801
Custer	128	5.63	3,368	1,539	7,300	.....
Delta	2	5.32	139	.....	.....	.....
Dolores	973	475.05	71,621	96,988	126,856	87,000
Eagle	5,148	991.30	74,158	209,551	30,327	.....
Fremont	29	.....	.....	.....	.....	18,072
Garfield	92	174.30	113	425	.....	.....
Gilpin	16,845	21,115.43	83,905	339,184	247,346	.....
Grand	1	.....	.....	56	.....	.....
Gunnison	531	36.61	14,939	4,076	184,549	176,815
Hinsdale	1,255	258.67	50,689	452,077	93,405	.....
Lake	324,261	53,722.65	3,044,053	3,624,237	12,424,001	16,869,270
La Plata	6,050	18,782.52	141,349	142	273	.....
Mineral	25,791	238.45	722,142	11,357	1,057,703	.....
Montezuma	320	353.44	189	123	.....	.....
Ouray	4,739	1,382.76	178,388	167,568	773,323	.....
Park	12,092	12,118.65	116,878	88,748	2,041,204	659,796
Pitkin	33,181	29.90	366,685	327	7,499,775	.....
Rio Grande	12	63.18	61	87	250	.....
Saguache	296	49.58	4,841	5,362	161,068	.....
San Juan	6,052	1,730.26	406,218	211,223	2,116,963	37,918
San Miguel	1,396	430.60	57,333	14,556	499,593	.....
Summit	2,660	345.64	28,316	6,122	238,856	834,104
Teller	32,309	73,261.54	25,880	.....	.....	.....
Total	514,008	209,734.19	5,915,292	5,940,262	29,498,027	19,406,315

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REVIEW BY COUNTIES.

BOULDER COUNTY.

Mine production of gold, silver, copper, and lead in Boulder County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	7,898.33	$163,273	6,768.19	$139,911	−1,130.14	−$23,362
Silver.....do....	48,133	25,055	46,517	25,119	− 1,616	+ 64
Copper.....pounds..	16,485	2,143	16,772	2,130	+ 287	− 13
Lead.....do....	425,605	18,301	53,250	2,343	− 372,355	− 15,958
Total.....	.....	208,772	.....	169,503	.....	− 39,269

From 85 mines in Boulder County in 1910 there were sold or treated 14,083 short tons of ore, as compared with a tonnage of 13,188 tons from 56 mines in 1909. The average recoverable value per ton in 1910 was $12.04, as compared with $15.83 in 1909, with $16.17 in 1908, and with $22.82 in 1907.

The total value of the ore produced in 1910 was $169,503, a decrease of $39,269. Decreases were chiefly in gold and lead.

In 1910, as in 1909, the greater part of the ore in Boulder County was treated in stamp amalgamation and concentration plants, with and without cyanide plants. In 1910 the tonnage of crude ore shipped to smelters was larger than in 1909, and the tonnage treated by mills increased. The average recovery per ton in bullion in 1910 by Boulder County mills was valued at $4 in gold and $0.05 in silver, a total of $4.05, as compared with $6.14 in 1909. The tonnage of concentrates produced in 1910 from amalgamation mills with concentrators and at mills for concentration only was less than half that of 1909, but the average value per ton was greater, being $48.50 per ton in gold, $2.836 in silver, and $0.787 in copper, a total of $52.12 per ton, as compared with $50.75 per ton in 1909, averaging $4.90 in gold, $12.90 in silver, and $32.95 in copper and lead combined. The total average recovery per ton in bullion and concentrates showed the average value of all milling ore to be $5.06 in gold, $0.12 in silver, $0.02 in copper, a total of $5.20 per ton, as against $5.61 in 1909.

The average value per ton of the smelting ore of Boulder County was $16.11 in gold, $3.89 in silver, and $0.70 in copper and lead, a total of $20.70 per ton, as compared with $39.74 in 1909.

Central district.—This district, near Jamestown, produced gold and silver in 1909 valued at $5,107, as compared with $19,494 in 1910 and with $30,770 in 1908. Nearly all the ore was shipped to smelters, the chief producers being the Grand Central and the Wano mines, with small lots from the John Jay and the Rip Van Dam mines.

Gold Hill district.—This district regained in 1910 the first place in point of total value of metallic production, which had fallen to Sugar Loaf district in 1909. The production was $59,664 in gold, 10,676 ounces of silver, 1,662 pounds of copper, and 47,334 pounds of lead, with a total value of $67,723, as compared with $56,436 in 1909 and with $69,113 in 1908. The tonnage from 23 mines was 7,180 tons,

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as compared with 1,267 tons from 9 mines in 1909. With the exception of the Gold Nugget mine, the ore from which was treated in the 50-ton amalgamation mill on the property, nearly all the ore was shipped to smelters. The principal producing mines were the Atchison, Big Horn, Cash-Birkin, Golden Eagle group, Emancipation, Golden Harp, Gold Nugget, Ingram group, Inter-Ocean, Prussian, and Richmond.

Grand Island district.—The total value of the output from 6 mines in this district in 1910 was $4,775. The bulk of the ore was shipped to smelters. The Copper Glance, Lost Lake, and Stranger mines were the chief producers. The Alton Mining & Milling Co., near Nederland, completed a 25-ton concentrating mill. The Ida Mining & Milling Co.'s mill, at Caribou, was idle in 1910.

Magnolia district.—The total production of gold and silver from this district was valued at $4,358, as compared with $12,436 in 1909. Small tonnages were shipped from the Cash, Fortune and New Year, Marv V, and Poorman mines.

Sugar Loaf district.—The tonnage from 27 mines in 1910 was 5,037 tons, as against 6,489 tons in 1909 from 16 mines. The total value of the output in 1910 was $54,610, as compared with $66,560 in 1909. The idleness of the Cashier mine and 75-ton concentration mill made an appreciable reduction in tonnage produced. The free-milling ore of the Logan and Clinton mines was treated in a small laboratory amalgamating plant; lower grade ore was shipped to smelters than in 1909. Ore from the Evening Star mine was shipped to smelter. The product from the Gladys mine was shipped as bullion. The Good Luck Mining & Milling Co.'s 50-ton cyanide plant was operated in July and August. The ore is a sulpho-telluride and the process used is similar to that of the Cripple Creek mills. The process of the Good Luck mill consists in roasting, amalgamation, leaching with cyanide, and zinc precipitation. Crude ore was shipped by the United States Gold Corporation from the Klondike mine. This company has completed a 150-ton cyanide plant. There was a considerable tonnage shipped from the Yellow Pine mine. The Zophar Mining & Milling Co. operated its 10-stamp mill, with 5-foot Huntington mill, Wilfley tables, and Monell slimers, for 10 months on ore from the Wood Mountain mine. Shipments to smelter were made from several other mines, chief of which were the Alpine Horn, Amalgam Thief, Doss, Herald, Hoosier, Little Jewel, Sugar Loaf, and Nancy.

Ward district.—The production of Ward district in 1910 was $19,983 in gold, 6,660 ounces of silver, 12,182 pounds of copper, and 2,548 pounds of lead, with a total value of $25,238. The value of the output in 1909 was $27,741. Crude ore and concentrates were shipped from the Milwaukee mine. The ore from the Ni Wot, Columbia, Dew Drop, and Byron mines of the Big Five Co. was part treated at the company's 50-ton concentration mill and part shipped to smelters. The product from the Morning and Evening Star Mining & Milling Co. was both in bullion and crude ore and concentrates shipped. Crude ore was also shipped from the Celestial Extension, Copper Mountain, Golden Queen, Myrtle, Protection, and White Raven mines.

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CHAFFEE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Chaffee County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,474.71	$30,485	3,732.23	$77,152	+2,257.52	+$46,667
Silver.....do....	35,477	18,448	182,003	98,282	+ 146,526	+ 79,834
Copper.....pounds..	568,868	73,953	226,772	28,800	− 342,096	− 45,153
Lead.....do....	584,492	25,133	970,523	42,703	+ 386,031	+ 17,570
Zinc.....do....	947,741	51,178	438,539	23,681	− 509,202	− 27,497
Total.....	.....	199,197	.....	270,618	.....	+ 71,421

The value of the metallic output of Chaffee County in 1910 shows an increase of $71,421 from increased shipments of ore from deep mines, the placer output showing a slight decrease in gold. The tonnage sold or treated in 1910 was 12,496 short tons, as compared with 10,214 tons in 1909. The tonnage for both years was all shipped to smelters, no mills being active in that county since 1908.

There were 23 productive deep mines and 3 placers. The increase in gold and silver was chiefly in the output from the Monarch district, with also an increase from the Chalk Creek district. The increase in lead output and the decrease in copper was chiefly from the change in the class of ore from the Monarch district. The tonnage of zinc ore from the Monarch district was less than in 1909.

Chalk Creek district.—There was a considerable increase in tonnage and in output of gold, silver, copper, and lead in this district in 1910. The principal operator was the Mary Murphy Gold Mining Co., which shipped an increased tonnage of lead ore to smelters, as well as doing considerable development work. The ore is a sulphide (partially altered to oxide) of zinc, lead, iron, and copper in a gangue of quartz and rhodonite, carrying gold and silver. In 1910 the zinc in the ore was not recovered. Small shipments of dry ore, carrying gold, silver, and lead were shipped from the Allie Bell and the Flora Bell mines.

Cleora district.—Small lots of lead and copper-lead ores were shipped from this district in 1910.

Granite district.—Nearly all the placer output of Chaffee County was from the Granite district in 1910. The Cache Creek Leasing Co., operating the Twin Lakes placer by hydraulicking, was the chief producer. Some small shipments of ore were also made from the Columbine and the Margaret mines.

La Plata district.—A small shipment of dry ore, carrying chiefly silver and lead, was shipped from the Banker group of mines.

Monarch district.[1]—This district is the principal camp of the county, yielding 10,828 short tons of ore in 1910, carrying $47,148 in gold, 167,637 fine ounces of silver, 116,857 pounds of copper, 904,930 pounds of lead, and 438,539 pounds of zinc, with a total value for all five metals of $216,011, as compared with $140,915 in 1909.

[1] See Crawford, R. D., A Preliminary Report on the Geology of the Monarch mining district, Chaffee County, Colo.: Bull. Colorado State Geol. Survey for 1909, No. 1, 1910.

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There were 9 shipping mines in the district. The Monarch-Madonna mine continued to be the chief producer, with an increased tonnage of lead and zinc ore. The public report of this company gives "Receipts in 1910 were $104,889; total profits, $68,194 from 5,820 tons of wet ore. Total production was: Gold, 2,162 ounces; silver, 153,634 ounces; lead, 684,776 pounds; copper, 156 pounds; zinc, 483,337 pounds." [1] The gross value of the output of the mine from 1883 to 1909, inclusive, was $4,535,543.94, of which $3,200,345.54 was for lead.[2] The figures of yearly output since 1883, published by Crawford,[3] with average assays for each year in gold, silver, lead, copper, and zinc, shows plainly the changing character of the ore with depth, from a low grade of gold and silver bearing lead ore to a nearly pure gold and silver ore of comparatively high grade. The zinc and lead ores are on the upper levels down to the so-called fifth level, while on the sixth, 400 feet lower, the ore is gold and silver with a little lead.

The Taylor Mountain Mining Co. shipped a considerable tonnage of oxidized copper ore, carrying also gold, silver, and lead. The output of this mine, from 1888 to January 18, 1910, has been 8,827 tons, of a gross value of $173,898.71, averaging $19.70 per ton. From March 17, 1906, to January 18, 1910, the output was 4,992 tons, carrying 757,163 pounds of copper (wet assay), silver, 17,743 ounces, lead, 4,637 pounds, and gold 67.44 ounces, a total gross value of $103,111, averaging $20.66 per ton. In 1909, the mine produced 1,832 tons with a gross value of $26,121.34.[4] Lead ore was shipped by the Giant-Eclipse Consolidated Mines Co., and by the Monarch Consolidated Mining Co., the latter operating the Hawkeye and Fairview mines. Lead and lead-zinc ore was shipped from the Wilson mine. Other smaller shipments of lead ore were made from the Mason, Rainbow and Eagle Bird, and Silent Friend mines. The Jewell Tunnel Co. continued its adit which was in 750 feet at the close of 1910.

Riverside district.—Copper ore from the Madeline mine and lead ore from the Mount Harvard mine was shipped in 1910.

Turret district (including Sedalia).—A decreased tonnage of copper ore was shipped in 1910 by the Sedalia Copper Co. Copper ore was shipped from the Turret Independence mine, and a small tonnage of gold and silver bearing ore was shipped from the Golden Wonder mine. A small quantity of placer gold was recovered by sluicing on the Brown's Canon placer.

CLEAR CREEK COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Clear Creek County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	25,948.69	$536,407	25,277.10	$522,524	− 671.59	−$13,883
Silver .....do....	448,535	233,238	475,174	256,594	+ 26,639	+ 23,356
Copper.....pounds..	299,546	38,941	595,795	75,666	+296,249	+ 36,725
Lead.....do....	3,254,675	139,951	2,434,476	107,117	−820,199	− 32,834
Zinc.....do....	758,074	40,936	1,247,389	67,359	+489,315	+ 26,423
Total.....	.....	989,473	.....	1,029,260	.....	+ 39,787

[1] Eng. and Min. Jour., Feb. 4, 1911, p. 288.
[2] Crawford, R. D., op. cit. p. 47.
[3] Crawford, R. D., op. cit. p. 47.
[4] Crawford, R. D., op. cit. pp. 58-60.

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The total value of the production of gold, silver, copper, lead, and zinc in Clear Creek County in 1910 was $1,029,260, as compared with $989,473 in 1909 and with $1,084,918 in 1908. There were decreases in output of gold and lead, but increases in silver, copper, and zinc. The decrease in gold production is shown to have come from a decrease in gold-bearing dry or siliceous ores; silver production from dry and lead ores also decreased, but increased from copper and zinc ores; the copper increase corresponds to the increase of 1,954 tons of copper ore of 2½ per cent tenor; lead contents decreased both in crude ore and in concentrates—the direct result of shipping ores from several mines to the copper matting plant at Golden instead of to the lead plants as heretofore. Production of zinc and lead-zinc ores combined shows a slight decrease in tonnage, the contents in zinc, however, being greater in both crude ore and concentrates, due to a higher percentage of zinc in crude ore sold or treated. There was also a lower ratio of concentration for zinc ores in 1910.

The output from the lower Clear Creek mines (Idaho, Jackson, Montana, and Trail districts combined) showed a slight increase in tonnage, with decreases in the output of all the metals except copper and zinc, while upper Clear Creek mines (Argentine, Empire, and Griffith districts combined) made a small decrease in tonnage output, but increases in gold, silver, and zinc production and decreases in output of copper and lead, with an increase in combined values.

There were 113 operators of producing mines or groups of mines, and there were also shipments of small lots from 34 other mines and prospects—a total of 147 properties from which there was some output in 1910, as compared with 146 properties in 1909. There were 10 producing placers in 1910, as compared with 4 in 1909. The tonnage sold or treated in 1910 was 109,954 short tons as against 116,753 in 1909 and 109,672 tons in 1908. The average total value per ton was $9.33, as compared with $8.44 in 1909 and with $9.87 in 1908.

The output from placers was $3,678 in gold from small sluicing operations near Idaho Springs.

The average gold and silver value per ton of siliceous ore was $6.51, of which $5.58 was gold; of copper ores, $68.96, of which $24.88 was gold; of lead ores, $12.27, of which $3.51 was gold; and of lead-zinc ores, $2.11, of which $0.17 was gold.

During 1910 there were treated at stamp amalgamation mills in Clear Creek County and in mills in Gilpin County 47,248 short tons of ore from Clear Creek County, and the bullion saved on the plates contained 2,833.83 fine ounces of gold, valued at $58,580, an average of $1.24 per ton, and 1,293 fine ounces of silver, valued at $698, an average of $0.01 per ton, a total value of gold and silver of $59,278 and an average total value of $1.25, as compared with $1.09 in 1909 and with $1.36 in 1908. From this ore and from 41,569 tons sent to mills for concentration only—a total to both classes of mills of 88,817 tons, or 80.7 per cent (as against 87.6 in 1909) of all the tonnage produced—there were produced 8,115 tons of concentrates (ratio about 11 to 1), containing 5,854.13 fine ounces of gold, valued at $121,016, an average of $14.91 per ton; 176,444 ounces of silver, valued at $95,280, an average of $11.74 per ton; 131,572 pounds of copper, valued at $16,710, an average of $2.06 per ton; 1,462,977 pounds of lead, valued at $64,371, an average of $7.93 per ton; and

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962,588 pounds of zinc, valued at $51,980, an average of $6.41 per ton—a total value of $349,357 and a total average value for concentrates in gold, silver, copper, lead, and zinc of $43.05 per ton, as against $41.23 in 1909.

There were produced from the 88,817 tons of ore to both classes of mills $179,596 in gold, from both bullion and concentrates, or an average of $2.02 per ton, and 177,737 ounces of silver valued at $95,978, or an average of $1.08, or a total average in gold and silver of $3.10 per ton (as compared with $3.73 in 1909) for all milling ore; and averaging $0.19 in value of copper, $0.725 in lead and $0.59 in zinc—a total average gross value per ton in all five metals of $4.60 for all milling ore, as against $5.08 in 1909.

Crude ore shipped to smelters amounted to 21,137 tons, which contained gold valued at $339,250 and 297,407 ounces of silver with 464,223 pounds of copper, 971,499 pounds of lead, and 284,801 pounds of zinc—with a total average gross value in all five metals of $29.19 per ton, as compared with $32.17 per ton in 1909.

Crude ore and concentrates combined shipped to smelters amounted to 29,252 tons, containing $460,266 in gold, 473,851 ounces of silver, 595,795 pounds of copper, 2,434,476 pounds of lead, and 1,247,389 pounds of zinc—a total average value of $33.03 per ton.

The average value in gold, silver, copper, lead, and zinc per ton of the entire tonnage mined and treated was $9.33, of which $4.72 was for gold, $2.34 for silver, $0.69 for copper, $0.97 for lead, and $0.61 for zinc.

Alice (or Yankee) district.—The total value of the production of 6 deep mines in 1910 was $2,728, as compared with $14,330 in 1909. The decrease was caused by the fact that only a very small tonnage from the Lombard mine was treated in 1910, the owners, the Continental Power, Mines Reduction Co., being occupied the full year in driving the Lombard adits, of which there are 5. The 15-stamp amalgamation and concentration mill will be run in 1911. Ore from the Little Lalla mine was milled. Crude ore was shipped from the Cumberland, Last Chance, Princess Alice, and Puritan mines.

Argentine district.—From 5 mines in this district there were sold or treated 4,700 short tons with a total value in five metals of $137,880, as compared with $88,224 in 1909. In 1910 the output was distributed as follows: Gold, $60,325; silver, 60,871 ounces, valued at $32,870; copper, 233,512 pounds, valued at $29,656; lead, 325,452 pounds, valued at $14,320; and zinc, 13,137 pounds, valued at $709.

The principal mine in 1910 was the Santiago, from which was shipped crude a considerable tonnage of copper ore carrying appreciable quantities of gold and silver. An increased tonnage was treated by the Waldorf Consolidated Mining Co. in the company's 100-ton concentration plant. Crude ore, as well as copper, lead, and zinc concentrates, was shipped to smelters. A few tons of zinc and lead concentrates were recovered from ore from the Morning Star group, treated at the Mendota mill. The Josephine mine was operated throughout the year, a considerable tonnage carrying a high per cent of lead and also gold and silver.

Empire (or Upper Union) district (including Camp Beshears).—This district from 11 mines produced a tonnage of 1,979 tons, carrying $29,634 in gold, 731 ounces of silver, 5,516 pounds of copper, and 43 pounds of lead, with a total value of $30,732, a decrease for

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1910 of $7,797. In 1909, from 4 mines, there were sold or treated 2,266 tons of ore, carrying $37,462 in gold, 1,675 ounces of silver, and 1,508 pounds of copper, with a total value of $38,529. In 1910, the greater part of the tonnage was milled. The Conqueror Mining, Reduction & Power Co. mined the largest tonnage, which was treated at the company's 40-ton concentrating plant, which comprises a crusher, 2 sets of rolls, jigs, 1 Wilfley table, and 3 Frue vanners. Ore from the Empire Mint and New System mines was treated at the New System Gold Mines Co.'s 10-stamp amalgamating and concentration mill. Ore from the Empire-Gold Bug mine was also treated at the New System mill. Shipments of crude ore to smelters were chiefly from the Gold Dirt group, with smaller shipments from the Comet, Elephantine, Golconda, Gold Fissure, Pioneer, and Silver Mountain mines.

There was one small lot from the new Camp Beshears district, between Georgetown and Empire, on Bard Creek. This camp first came to public notice about July, 1910. Some development has been done since that time, and about 50 tons have been shipped during the spring of 1911.

Griffith district.—The output of metals from 20 mines or groups of mines in the Griffith district in 1910 from 37,891 tons of ore sold or treated was $44,356 in gold, 203,300 fine ounces of silver, 288 pounds of copper, 1,319,203 pounds of lead, and 1,202,274 pounds of zinc, with a total value for the five metals of $277,143, as compared with $231,639 in 1909, and with $203,190 in 1908. The tonnage in 1910 was 7,523 tons less than in 1909. There were small decreases in the yield of gold, copper, and lead, but considerable increases in silver and zinc. This district produced 96.4 per cent of the zinc output of the county.

Of the 37,891 tons of ore mined, 36,684 tons were treated in amalgamating and concentration mills, the tonnage of concentrates resulting being 3,472 tons. The above 3,472 tons of concentrates with 1,207 tons of crude ore, a total of 4,679 tons, were shipped to smelters, and contained the metals produced, with the exception of the gold and silver saved on the plates.

The Capital Mining & Tunnel Co., at Georgetown, operated the mine during the entire year, but the mill was not operated steadily, so that a decreased tonnage was treated in 1910. The mill is a 100-ton amalgamation and concentration mill, crushing and grinding being done with crushers and two 6-foot Chilian mills. The product is gold and silver bullion, and concentrates carrying gold, silver, and lead. A considerable tonnage of dump ore from the Pelican dump and some crude ore from the Dives-Pelican and Seven-Thirty mines was treated by the Burleigh Mining & Milling Co. at Silver Plume, in the Burleigh mill, and produced a silver-lead concentrate, carrying a little gold, and a zinc concentrate, carrying a little lead, silver, and gold. A portion of the dump was also treated in the Scotia mill and produced both zinc and lead concentrates. Lessees also mined lead ore from the Dives-Pelican-Seven-Thirty group. A considerable tonnage of lead-zinc ore, carrying silver and some gold, was mined from the Mendota-Frostburg group and treated at the 60-ton Mendota mill, yielding lead and zinc concentrates. The 50-ton concentration mill of the Linn Consolidated Mining Co., at Georgetown,

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was operated until the end of May, when it was closed. Lead and zinc concentrates were shipped. Lead-zinc ore from the Smuggler mine was also treated at the Mendota mill. Crude zinc ore was shipped from the Joplin Tunnel property. Small shipments were also made from the Aliunde, Anamosa, Anglo-Saxon, Aster-Scepter, Kelly Tunnel, Cliff, Boston, Dunkirk, East Griffith, Little Giant, and West Griffith mines.

Idaho district.—In this district are included the mines about Idaho Springs, including Banner, Coral, Lower Fall River, Payne's Bar, Spanish Bar, and Virginia subdistricts.

In 1910 there were 56,605 tons of ore mined in the Idaho district, as compared with 52,564 tons in 1909 and with 66,147 tons in 1908. The production of metals from deep mines in 1910 was $294,251 in gold, 171,248 ounces of silver, 314,759 pounds of copper, 688,114 pounds of lead, and 31,978 pounds of zinc, with a total value for the five metals of $458,703, as compared with $530,302 in 1909 and with $707,838 in 1908.

In 1910, of the 56,605 tons mined, 45,770 tons of ore were treated at amalgamating mills with concentrators and at mills for concentrating only and yielded 3,485 tons of concentrates. These 3,485 tons of concentrates and 10,835 tons of crude ore, 14,320 tons in all, were shipped to smelters, and contained all the gold and silver (with the exception of 1,982.84 fine ounces of gold valued at $40,989, and 953 fine ounces of silver valued at $515, in mill bullion) and all the copper, lead, and zinc produced.

The Gem Consolidated mines, worked through the Newhouse tunnel, by lessees, yielded a decreased tonnage in 1910. Part of this ore is shipped to smelters, but more than half is concentrated at the company's concentrating plants at Idaho Springs. Crude ore from the Little Mattie group, on the south side of Clear Creek, was shipped to smelters, but, as in 1909, the bulk of the ore was treated in the company's 30-stamp plate-amalgamation and concentration mill. Ore from the Shafter mine, worked through a lateral from the Central tunnel, was shipped crude and as concentrates, the latter produced at the 20-stamp plate-amalgamation and concentration custom mill of the Hudson Reduction Co. Dry ore from the Specie Payment mine was treated at custom concentrating plants at Idaho Springs, yielding a lead-copper concentrate, carrying appreciable quantities of gold and silver. Ore from the Stanley mines was shipped crude and treated at the company's 50-ton concentration mill. Lessees on the Sun and Moon group [1] shipped crude dry ore, carrying gold, silver, and copper, to the semipyritic plant at Golden. There was a considerable tonnage of gold-silver ore mined from the Treasure Vault mine in 1910, part of which was treated by plate-amalgamation and part was shipped crude to smelters. Ore from the Refugee mine, on a continuation of the Shafter vein, was treated at the Hudson Reduction Co.'s amalgamation and concentration mill. Ore from the Elliott and Barber, the Josephine and Lincoln mines was shipped crude or treated at the mill of the old Lincoln company, by the Tanquay company. Ore from the mines of these 9 companies constituted almost 75 per cent of the tonnage produced and carried almost 90

[1] The ore from this mine is reported to come from the Clear Creek County side. Surveys show that the ore-bodies mined in 1910 lie very close to the Clear Creek-Gilpin line.

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per cent of the gold, almost 70 per cent of the silver, over 90 per cent of the copper, and almost 70 per cent of the lead, of the Idaho Springs district.

The Big Five Ore Reduction & Tunnel Co. operated the Edgar and Belman mines. This tunnel, also known as the Central, was 8,975 feet long at the end of the year 1910. The ore was both milled and smelted. Crude lead ore and lead-zinc ore[1] was shipped from the Bride mine in the Newhouse tunnel. A considerable tonnage was also shipped from the Dike mine in this tunnel. Ore from the Clarissa and Blue Bell mines was treated at the Boneita and the Mixsell mills. Lessees shipped a considerable tonnage chiefly of lead-silver ore but also of dry ore, carrying gold, silver, and copper, from the Franklin and Silver Age mines. Both milling and smelting ore was shipped from the Lake mine, which was cut by the Central tunnel in 1910. Lead and lead-zinc ore[1] was shipped to mills and smelters from the Seaton and Seven-Twenty mines.

In the Virginia Canyon district, near the Gilpin County line, milling and smelting ores were mined from the Castleton, Champion-Trio, Crown Point, and Victor mines. Up Fall River, operators of the Almaden mines shipped several cars of ore. The Lucania tunnel, starting near the mouth of Fall River, was 4,750 feet long at the close of 1910. Milling and smelting ore was shipped from the Kinda mine, on the line of the Lucania tunnel. Small shipments were made from the Philadelphia mine.

Jackson district.—From 8 mines and prospects, in 1910, in this district, on Cascade, Chicago, and Ute creeks, above Idaho Springs, there were 1,295 tons of ore mined. Of this, all but 52 tons was milled. The Honest John Mining & Tunnel Co. shipped ore from the Black Eagle mine. The Humboldt Mining & Tunnel Co. treated ore from the dump of the Humboldt mine in the company's 10-stamp plate-amalgamation mill. The greater part of the ore from the Katie Emmett mine was treated in a 3-ton plate-amalgamation mill. Some ore from the Quito group was concentrated. Other producing mines were the Heddensburg, Little Rich, Solid Muldoon, and Yellow Jacket.

Montana district.—From 10 mines in this district, near Dumont and Lawson, there were 344 tons mined, carrying $1,687 in gold, 6,609 ounces of silver, 8,964 pounds of copper, and 42,852 pounds of lead, with a total value of $8,279. Shipments of copper ore were made from the Albro mine. From the Blue Ridge, Princess of India, and Syndicate mines, ore was sent to concentrating mills and smelters. Shipments to smelters were also made from the Commodore, Ben Harrison, Joe Reynolds, Lost Treasure, and Millington mines.

Trail Creek district.—There was an increase in the total output from this district in 1910. From 10 mines, there were mined 6,906 tons, carrying $82,873 in gold, 30,778 ounces of silver, 32,227 pounds of copper, and 57,454 pounds of lead, with a total value of $106,114. The chief operator in 1910 was the North American Smelter & Mines Co., which shipped sulphide ores containing gold, silver, copper, and a small quantity of lead, from the Donaldson, Magalona, Centurion, Champion, Comstock, and other mines, to the company's copper-matting plant at Golden. A considerable tonnage of similar ore was

[1] These shipments of zinc-bearing ore on a zinc basis marks the first shipments of this kind of ore as such in this district.

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shipped from the Oneida mine to the smelter at Golden. Ore from the New Era mine was shipped to Golden and other smelters. From the Lamartine and Money Musk mines, an iron and lead sulphide was shipped to smelters or treated at the company's 40-ton concentrating plant. Ore from the Big Chief mine was treated in a small testing plant, by amalgamating and cyaniding. Shipments were also made from the Avalanche, Freeland, Freeland Extension, Silver Horn, and Turner mines.

CONEJOS COUNTY.

There was no production in Conejos County in 1910.

COSTILLA COUNTY.

The Colorado Gold Dredging Co., with a Hammond dredge, of the close-connected type, of 54 buckets of 4 cubic feet capacity each, or 2,000 cubic yards per day, operated from July through October in 1910 at Russell, in the Grayback mining district, on Placer and Sangre de Christo creeks. This company has purchased 240 acres from the Trichera Estate and owns about 3 miles of placer ground 300 feet wide.[1]

There are other placer holdings in the district which are to be worked by sluicing and hydraulicking. There are some lode prospects in the district.

CUSTER COUNTY.

From 9 mines in Custer County in 1910 there were sold or treated 7,052 tons, from which were recovered $9,839 in gold, 7,767 ounces of silver, 3,882 pounds of copper, 14,796 pounds of lead, and 6,796 pounds of zinc, with a total value for the five metals of $15,544, as compared with $27,191 in 1909, a decrease for 1910 of $11,647.

There were appreciable decreases in output of all the metals except copper.

The greater part of the tonnage was dry or siliceous ore. Most of the dry ore was milled; some lead-zinc ore was milled, and the remainder was shipped to smelters.

Lessees treated ore from the dump of the Bassick mine at Querida in a 100-ton cyanide plant. The company did development work on the mine and blocked out ore for milling. Several cars of ore were shipped from mines near Silver Cliff during the year.

The Marion Mines & Mill Co., at Fairview, almost 45 miles southwest of Pueblo, in the Greenhorn Range, was occupied in 1910 in completing its 100-ton wet concentrating plant for the treatment of copper-lead-zinc sulphide ore.[1] A trial run was made in 1910. Both mining and milling machinery are run by water power.

[1] See Julian, Charles, Gold dredging in Costilla County, Colo.: Mining Science, May 25, 1911, pp. 540–542. Also Patton Smith, Butler, and Hoskins, Geology of the Grayback mining district, Costilla County, Colo.: Bull. Colorado State Geol. Survey for 1909, No. 2, 1910.

[1] See Parmalee, H. C., Zinc-ore dressing in Colorado: Metall. and Chem. Eng., October, 1910, pp. 566–570.

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DELTA COUNTY.

There was a very small shipment from this county in 1910.

DOLORES COUNTY.

Dolores County in 1910 produced 2,933 short tons of ore, containing $15,327 in gold, 88,309 ounces of silver, 97,063 pounds of copper, 127,909 pounds of lead, and 87,000 pounds of zinc, with a total value for the 5 metals of $85,667, as compared with $110,753 in 1909 and with $193,281 in 1908. There were 13 producing properties. There were important decreases in the yield of all the metals except copper, the output of which increased 53,525 pounds.

Lone Cone (or Dunton) district.—The chief mines in this district are the Emma and the Smuggler-Almont. Both properties have concentrating mills, the first a 30-stamp, 100-ton plant and the second a 20-stamp mill. Crude ore and concentrates were shipped in 1910 from both mines. Crude ore was shipped also from the Amoretta, the Rosebud, and the Pettit properties.

Pioneer (or Rico) district.—In 1910 less ore was mined from this district than in 1909. There was a reduced yield of all the metals, except copper. All the ore was shipped to smelters, and was lead ore or lead-zinc ore, much of that which is classified as lead carrying about 10 per cent of zinc, which was penalized at the lead smelter. The principal producers were the General Sheridan and the United Rico mines. Other mines from which ore was shipped were the Black George, Butler and Nellie Bly, Lillie D, Revenue, Swansea-Newman, and W. J. Bryan.

DOUGLAS COUNTY.

There was a small quantity of placer gold sluiced out in Newlins Gulch, near Parker, in Douglas County.

EAGLE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Eagle County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	2,578.77	$53,308	1,220.55	$25,231	− 1,358.22	−$28,077
Silver.....do....	125,214	65,111	88,313	47,689	− 36,901	− 17,422
Copper.....pounds..	286,885	37,295	209,551	26,613	− 77,334	− 10,682
Lead.....do....	152,280	6,548	397,409	17,486	+ 245,129	+ 10,938
Zinc.....do....	740,408	39,982	4,147,945	223,989	+3,407,537	+184,007
Total.....	.....	202,244	.....	341,008	.....	+138,764

The value of the metal output of Eagle County in 1910 was $341,008, as compared with $202,244 in 1909, an increase for 1910 of $138,764. There were important decreases in output of gold, silver, and copper, a moderate increase in lead, but a heavy increase in zinc. Eagle County became the third county in rank in the production of zinc.

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In 1910 there were 13 mines, 1 of which was a placer, as compared with 14 deep and 2 placer mines in 1909. There was a large increase in tonnage to separating mills, but a decrease in tonnage to smelters. The gross value per ton in terms of recovered metals was $12.27, of which $0.89 was for gold, $1.72 for silver, $0.96 for copper, $0.63 for lead, and $8.07 for zinc. The ore to smelters averaged per ton $3.98 in gold, $7.78 in silver—a total in gold and silver of $11.76, as compared with $17.43 in 1909—and also averaged $5.17 in copper and $0.26 in lead, a total per ton for the four metals of $17.19.

Battle Mountain district.—Lead-zinc ore from the Iron Mask group was treated in the company 60-ton magnetic separation mill, yielding a lead and a zinc concentrate. Some crude lead ore was also shipped from this mine. Lessees on the Rocky Point mine shipped a copper-sulphide ore, carrying gold and silver. Oxidized ore carrying gold, silver, and lead was shipped from the Pine Martin group. Lessees shipped ore from the Ground Hog mine. Other mines from which shipments were made were the Ben Butler, Little May, Golden Comet, Foster-Wilkesbarre-Wyoming Valley, Star of the West, and Whipsaw mines.

McDonald district.—Gold was sluiced from the Weldon and Tepee Creek placers, near Burns.

Girard Mountain district.—Copper ore was shipped in 1910 from the California and the Black Tiger mines.

FREMONT COUNTY.

A small shipment of zinc ore was made from Cotopaxi, Fremont County, in 1910.

GARFIELD COUNTY.

The camp of Goldstone, on East Elk Creek, 9 miles from Newcastle, Garfield County, had its beginning in 1909. Shipments of sulphide ore carrying gold, silver, and copper were made from the Grey Eagle mine in 1910. This mine is opened by a 400-foot tunnel.

GILPIN COUNTY.

Mine production of gold, silver, copper, and lead in Gilpin County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	42,923.67	$887,311	33,277.26	$687,902	−9,646.41	−$199,409
Silver.....do....	172,010	89,445	132,635	71,623	− 39,375	− 17,822
Copper.....pounds..	499,146	64,889	534,244	67,849	+ 35,098	+ 2,960
Lead.....do....	664,581	28,577	575,477	25,321	− 89,104	− 3,256
Total.....	.....	1,070,222	.....	852,695	.....	− 217,527

In 1910 Gilpin County produced 83,631 short tons of ore, as compared with 111,118 tons in 1909, a decrease of 27,487 tons. There were 116 companies or individuals operating deep mines or groups of mines, and there were 41 small lots of ore produced from other prop-

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erties, making a total of 157 mines or groups of mines from which ore was mined, as compared with a total of 244 in 1909. A small output from 5 placers was reported.

The production of gold in 1910 was $687,902, a decrease of $199,409. The production of silver was 132,635 fine ounces, a decrease of 39,375 ounces. Gold and silver production from bullion and concentrates was less than in 1909, but there was an increase in gold from smelting ore.

The output of both gold and silver from siliceous, copper, and lead ores decreased.

The siliceous ore mined in 1910 amounted to 82,291 tons, a decrease of 25,493 tons. The output of copper and lead ores also decreased.

The average value per ton of siliceous ore in gold and silver was $8.21, of which $7.45 was gold.

During 1910 there were treated at the amalgamation mills in Black Hawk and Idaho Springs 47,211 tons of ore from Gilpin County, and the bullion saved on the plates was valued at $115,269 in gold, an average of $2.44 per ton, and there was recovered 1,275 ounces of silver, valued at $689, an average of $0.02 per ton, a total value per ton in gold and silver of $2.46. From this ore treated at amalgamation mills and from 19,575 tons of ore sent to mills for concentration only—a total for both classes of mills of 66,786 tons, or 79.8 per cent of all tonnage produced—were produced 9,066 tons of concentrates, valued at $135,363 in gold, an average value of $14.93 per ton, and 49,449 ounces of silver, valued at $25,622, an average of $2.83 per ton, a total in gold and silver of $160,985 and an average of $17.76 per ton; in addition to gold and silver, the concentrates contained 195,060 pounds of copper, valued at $24,773, an average of $2.73 per ton, and 328,131 pounds of lead, valued at $14,438, an average of $1.59 per ton—a total average value per ton for concentrates in gold, silver, copper, and lead of $22.08, as compared with $24.25 in 1909. Those concentrates which contained copper averaged 1.76 per cent in that metal, and those which contained lead averaged 3.8 per cent of lead.

There were recovered from the total milling ore $250,632 in gold from both bullion and concentrates, an average of $3.753 per ton, and 48,724 ounces of silver, valued at $26,311, an average value of $0.394, a total in gold and silver of $276,943, and an average of $4.15 per ton, as compared with $5.90 in 1909.

Crude ore shipped to smelters amounted to 16,845 tons, containing $436,495 in gold, averaging $25.91 per ton, and 83,905 ounces of silver, valued at $45,309, averaging $2.69 per ton, a total in gold and silver of $481,804, and an average of $28.60 for the two metals; crude ore also contained 339,184 pounds of copper, valued at $43,076, an average of $2.56 per ton, and 247,346 pounds of lead, valued at $10,883, an average of $0.65 per ton, a total value for smelting ore in gold, silver, copper, and lead of $31.81 per ton, as compared with $30.76 per ton in 1909.

Work in driving the Newhouse tunnel, which at the close of 1909 had been driven 20,978 feet and had passed under Quartz Hill and Nevada Gulch, was resumed in April, 1910. On November 19, the tunnel was completed, when it reached a point under the Gunnell mines, in the Eureka district, west of Central City, its total length being 21,968 feet. During the year several laterals of the tunnel

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were run. The tunnel level, with respect to Quartz Hill and Gunnell Hill properties, is at a depth of from 1,500 to 1,700 feet, which in the majority of the mines will be from 400 to 700 feet below the depths of their present shafts.

Gilpin County is divided by somewhat indefinite lines into mining districts, having local names which appear to differ with individuals.

Central district.—The production in 1910 from this district, which embraces Central City, was one-half of that in 1909. Most of the ore was milled, though there was a slightly increased tonnage to smelters. Producing mines were the Dean and Castro, Freedom, Harsh, Huddleston, Keystone, Pacific, and Sadie A.

Enterprise district.—The total value of the output from this district in 1910 was $2,811. Small tonnages were mined from the Centennial, Howard, Lily, Milton, and Two Lassies mines. In its canvas plant the Clear Creek Mining and Milling Co. recovered copper concentrates carrying gold and silver, from mill waste.

Eureka district.—This district, west of Central City, embraces Gunnell Hill and Eureka and Prosser gulches. The total value of the output in 1910 was $26,603, as against $51,927 in 1909. There were decreases in tonnage output and in yield of gold, silver, copper, and lead. Although there was an increased tonnage from the Gunnell group, most of which was milled, there were smaller outputs from the other mines in this district. Only a small tonnage was marketed from the Eureka mine, as the company was building a 10-stamp concentration mill and blocking out ore in the mine. A small tonnage was also mined from the Concrete group, and from the Bullion, Gold Collar, Grand Central, Independent, and Ready Cash mines.

Gregory district.—This district embraces the town of Black Hawk, and the Gregory, Bobtail, and Bates hills. In 1910, as in 1909, it was the second district in importance of production, the first being Russell. In 1910, there were 24 mines, which produced altogether 16,014 tons of ore, from which was recovered $71,005 in gold, 12,433 ounces of silver, 27,963 pounds of copper, and 26,559 pounds of lead, with a total value of $82,439, as compared with $266,958 in 1909 and with $289,504 in 1908.

Among producing mines in this district were the Chicago-Carr, Dump Lode, Fifty Gold Mines group, Klein-German, Nemaha, Next President, O. K., Ontanogan, Puzzle, Running Lode dump, Sayre-Mammonth, Senator, Sleepy Hollow, Susan Mary, and U. P. R.

The Fifty Gold Mines Corporation, operating the Gregory, Bobtail, Fiske, Cook, and other properties, closed all work on company account at the end of March. Desultory work by lessees was continued during the year. The company's 80-stamp, 350-ton amalgamation and concentration mill was also closed to custom ore. Work on the Sleepy Hollow mine, on company account, was closed after the Fifty Mines closed, because of the danger of water from the Fifty Mines property. Lessees continued to take out some ore from this mine. The U. P. R. (or Gregory Buell) 45-stamp custom mill was idle part of the year. Company work on the O. K. mine closed early in the spring. The mine and the company 50-ton mill of the Next President mine were closed in March.

Illinois Central district.—The output in 1910 from this district, which lies about 1 mile south of Central City and embraces Illinois and Leavenworth gulches and the east portion of Quartz Hill, almost

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equaled the tonnage of 1909, but there was a decrease in the yield of metals, the total value being $44,270 as compared with $52,792 in 1909. Among producing mines were the Alps, Baxter, Calhoun, East Missouri, Egyptian, Gladstone, Hayes and Wheeler, Kirk, Paola, and Quartz mill.

Lake district.—This district, 1 mile southeast of Central City, and generally known as Lake Gulch, produced a slightly decreased tonnage, but the gold and silver contents were greater than in 1909. The New National Tunnel group, the Pittsburg, and the West Notoway were the chief mines in 1910.

Nevada district.—This district, embracing the vicinity of Nevadaville, was again third in rank of production, but showed a considerable decrease in output for 1910. There were 13 producing mines, as against 20 in 1909. Among producing mines were the Alger-Kansas, California, Columbia Tunnel group, East Flack, First National-Kansas, Forks, Hubert, Mitchell, Phoenix-Burroughs, San Juan, and West Baker. There were produced 5,508 tons of ore, from which were recovered $47,703 in gold, 6,102 ounces of silver, 6,409 pounds of copper, and 55,939 pounds of lead, with a total value of $54,273, as compared with $99,863 in 1909.

Quartz Valley district.—The center of this district lies 1 mile north of Central City. The total value of the production was $3,144. The producing mines were the Hayseed Tunnel, Margaret Glennon, and Queen of the West.

Russell district.—The Russell district lies southwest of Central City, extends to the Clear Creek County line, and is the most important district in Gilpin County. The total production in 1910 was 39,048 tons of ore, from which were recovered $368,130 in gold, 91,380 ounces of silver, 387,399 pounds of copper, and 438,033 pounds of lead, the total value of the output being $485,948, as compared with $441,871 in 1909, an increase for 1910 of $41,077.

Among the mines producing precious metals alone in 1910 were the Chase and the Rockford. Among mines producing copper in addition to gold and silver were the Argo, Aurora, East Leavenworth, East Notoway, Federal, Gibson, Japan-Lizzie group, Gulch, Hall, Old Town group, Pewabic mines, Russell, Saratoga, Silver Dollar, and Wardance. Among mines producing lead in addition to gold and silver were the Lucky Strike and Stewart, and among mines producing both copper and lead in addition to gold and silver were the Aduddell-Frontenac, Anchor-Helmer, Druid, King Bee, Topeka, and Two-Forty.

The Frontenac Consolidated Mines (Ltd.), operating the Aduddell-Frontenac mines, built a 250-ton concentrator at Black Hawk in 1910. The company operated its own plant, the Iron City mill, until August, when work was commenced on the new mill. This mill is designed as a straight concentration mill, with crushing by rolls instead of by stamps.

Northern districts.—The outlying districts in Gilpin County are Vermilion district, 4 miles northwest of Central City; Pine district, 7 miles northwest of Central City; Independent and Union districts, above 9 miles north of Central City, embracing Perigo and Rollinsville, Lump Gulch, and Moon Gulch sections; and Phœnix district, along the north edge of the county, near the Boulder County line.

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Independent and Union districts.—Near Perigo and Rollinsville were the principal mines in the outside districts. There were 7,201 tons from this district sold or treated in 1910, the value of the recovered metals being $54,608, of which $52,447 was gold. Over 92 per cent of the tonnage was milled. Ore from the Smuggler mine was treated in the company's 10-stamp amalgamating and concentration mill. Ore from the Golden Flint was also milled. Lessees on the Perigo Mines group treated the ore in the plate-amalgamation mill on the property and also shipped crude ore to smelters. Crude ore, containing principally gold, was shipped from the Lone Star mine, and ore from the Free Gold mine was milled.

Pine (or Wisconsin) district.—There was a small tonnage of ore mined in this district from the Alaska, Bullion No. 2, Mascot, and Sherman mines. A small tonnage was also mined from the London group, in Twelve Mile gulch.

GRAND COUNTY.

There was less than a ton of copper ore shipped from the Mollie Groves mine, near Parshall, in Grand County.

GUNNISON COUNTY.[1]

Mine production of gold, silver, copper, lead, and zinc in Gunnison County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	5,248.35	$108,493	11,318.40	$233,972	+6,070.05	+$125,479
Silver.....do....	37,423	19,460	49,189	26,562	+ 11,766	+ 7,102
Copper.....pounds..	51,815	6,736	21,024	2,670	− 30,791	− 4,066
Lead.....do....	493,070	21,202	581,841	25,601	+ 88,771	+ 4,399
Zinc.....do....	212,093	11,453	176,815	9,548	− 35,278	− 1,905
Total.....	.....	167,344	.....	298,353	.....	+ 131,009

The value of the mineral output of Gunnison County in 1910 showed a heavy increase over that of 1909 in gold, and a moderate increase in silver and lead, with small decreases in the yield of copper and zinc, the total increase being $131,009. The increase in gold was in the Cochetopa and Gold Brick districts. Lead and zinc production decreased in the Tomichi (Whitepine) district, but there was a heavy increase in lead in the Gold Brick district. There were 25,203 tons of ore sold or treated in the county in 1910, as compared with 9,071 tons in 1909.

Box Canon (or Waunita Hot Springs) district.—A test run was made in the 10-stamp amalgamation and concentration mill at the Camp Bird mine.

Cochetopa (or Sillsville) district.—Lessees on the Maple Leaf mine, at Sillsville, produced a heavily increased quantity of bullion and concentrates from the 40-ton amalgamation and concentration mill on the property.

[1] For a brief account, see Hill, J. M., Notes on the economic geology of southeastern Gunnison County, Colo.; Bull. U. S. Geol. Survey No. 380, 1909, pp. 21–40.

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Elk Mountain (or Crested Butte) district.—There was no production from this district in 1910.

Gold Brick (or Ohio) district.—This district in 1910, as in 1909, was the leading district in Gunnison County, with Cochetopa district second, followed closely by Tomichi district. Bullion and lead concentrates were the products from the amalgamation and concentration mill of the Gold Links mine. Bullion from the Revenue mine was shipped to the mint.

Quartz Creek (or Pitkin) district.—A small quantity of bullion was produced from the Pandora mine.

Rock Creek (or Crystal) district.—A small tonnage of gold-silver ore was shipped from the Black Queen mine.

Tin Cup district.—A small shipment of lead ore was made from the Blistered Horn mine. Concentrates were shipped from the 200-ton concentration plant of the United Colorado Mines Co., at Dorchester, 23 miles north of Tin Cup.

Tomichi (or Whitepine) district.—A little more gold was produced in this district in 1910 than in 1909, but there were decreases in output of silver, copper, lead, and zinc. Lead ore was shipped from the Doctor mine, lead and lead-zinc ore from the Morning Star mine, and copper ore from the Taylor Park mine.

HINSDALE COUNTY.

Mine production of gold, silver, copper, and lead in Hinsdale County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	367.02	$7,587	305.73	$6,320	− 61.29	−$1,267
Silver.....do....	75,731	39,380	54,422	29,388	− 21,309	− 9,992
Copper.....pounds..	714,569	92,894	465,472	59,115	−249,097	−33,779
Lead.....do....	106,327	4,572	296,182	13,032	+189,855	+ 8,460
Total.....	.....	144,433	.....	107,855	.....	−36,578

In 1910 Hinsdale County produced 3,468 short tons of ore, an increase of 1,771 tons, as compared with 1909. The total value of the production, however, decreased from $144,433 to $107,855. There was a decrease in gold, silver, and copper, but a considerable increase in lead production.

From 2,213 tons of ore (or over 60 per cent of the entire tonnage) shipped to concentrating mills were produced 245 tons of concentrates containing $973 in gold and 3,733 ounces of silver valued at $2,016, with an average value per ton in these two metals of $12.20, of which $3.97 was for gold. Concentrates also contained 13,395 pounds of copper, averaging $6.94 per ton, and 202,777 pounds of lead, averaging $36.42 per ton, a total average value for concentrates of $55.56 per ton.

Crude ore to smelters amounted to 1,255 tons, containing $5,347 in gold, averaging $4.261 per ton; 50,689 ounces of silver valued at $27,372, averaging $21.81 per ton; 452,077 pounds of copper, aver-

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aging in value $45.748 per ton; and 93,405 pounds of lead, averaging $3.275 per ton; a total average value for smelting ore of $75.09 per ton.

Galena district.—This is the chief district in Hinsdale County. The yield from 8 mines was the bulk of the county production. The Frank Hough mine, the ore of which carries gold, silver, and copper, was the principal producer. A considerable tonnage of lead ore from the Ajax and Moro mines was milled in the Hanna Co.'s concentration plant. Lead concentrates were also shipped from the California mill. Crude ore was shipped to smelters from the Fanny Fern, Cleveland, Cora-Sulphuret, and Yellow Medicine mines.

Lake district.—In this district in 1910 there was a metal output valued at $3,096, as compared with $10,818 in 1909 and with $7,530 in 1908. Ore was shipped from the Argenta, Golden Fleece, and Pelican mines.

HUERFANO COUNTY.

About 1,000 feet of development work, including an adit 754 feet long, has been done on the Malachite mine, on the north slope of Culebra Mountain, near Malachite, in the southwestern part of Huerfano County.

JACKSON COUNTY.

Some development work was done at the mines near Pearl in Jackson County.

LAKE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Lake County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	69,433.97	$1,435,431	58,685 36	$1,213,134	−10,753.61	−$222,297
Silver.....do....	3,423,642	1,780,294	3,322,015	1,793,888	− 101,627	+ 13,594
Copper.....pounds..	5,182,608	673,739	3,645,157	462,935	−1,537,451	− 210,804
Lead.....do....	21,073,992	906,182	19,249,503	846,978	−1,824,489	− 59,204
Zinc.....do....	38,637,315	2,086,415	56,367,445	3,043,842	+17,730,130	+ 957,427
Total.....	.....	6,882,061	.....	7,360,777	.....	+ 478,716

The generally increased activity in Leadville mines in 1909 continued in 1910, and toward the end of the year the discovery and further verification of the existence of considerable quantities of zinc carbonate and zinc silicate in the workings and dumps of many of the mines, both idle and active, gave a material impetus to the zinc industry of Leadville. There was an increase in tonnage of ore and of old dumps sold, treated, or removed for treatment. Besides a considerable tonnage of zinc carbonate shipped, the tonnages of zinc sulphide and iron sulphide increased, but the tonnages of siliceous lead oxide and iron-manganese ores decreased. There was a larger tonnage milled in 1910, the recovered contents in concentrates

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averaging less in gold and silver but more in lead and zinc than in 1909. There was a slight decrease in the quantity of ore sent to smelters, and the metals recovered from this ore were all less in quantity except zinc.

The tonnage of zinc and lead-zinc ores sold or treated or removed for treatment was 171,277 tons, as compared with 127,640 tons in 1909. The content of the ore in 1910, figured as spelter, was 56,367,445 [1] pounds of zinc, as compared with 38,637,315 pounds in 1909, with 23,188,080 pounds in 1908, and with 37,412,374 pounds in 1907.

Lake County again ranked second to Teller County in value of production; in tonnage, Teller County was first, San Miguel County second, and Lake County third. The Lake County tonnage was 19 per cent and the value 22 per cent of the respective State totals. This county was again first in the production of silver, copper, lead, and zinc, and in the production of gold it followed after Teller, San Miguel, and Ouray counties.

Of the total State output Lake County produced 39 per cent of the silver, 25 per cent of the lead, 44 per cent of the copper, and 73 per cent of the zinc.

In 1910, from 104 deep mines there was sold or treated 462,033 short tons, as compared with 96 producing properties and 417,297 tons in 1909. In quantity the increase was 44,736 tons, but the total average value decreased from $16.49 per ton to $15.92 per ton.

Classification of Leadville ore.

	Quantity.	Quantity.	Percentage.
Sulphide:	*Short tons.*	*Short tons.*	
Zinc-iron-lead (zinc blende; pyrite with a little galena)	163,218	163,218	35.3
Iron (pyrite, with a little copper, gold, silver, and lead)	160,590	168,208	36.4
Iron (pyrite, with a little copper, gold, silver, and over 4½ per cent lead)	7,618		
Total sulphide		331,426	71.7
Oxide:			
Lead	18,581	18,671	4.0
Copper-lead	90		
Iron-manganese (silver)	82,597	82,597	17.9
Zinc carbonate and silicate	8,059	8,059	1.8
Total oxide		109,327	23.7
Siliceous (principally oxide [a]):			
Gold-silver	21,280	21,280	4.6
Grand total	462,033	462,033	100.0

[a] Nearly all the siliceous ore is also oxide and all is dry. Pure metallic gold in quantity 3,920.90 ounces valued at $81,052 came from less than a ton of ore, from sulphide ore bodies.

As shown by this table the greatest (and the increasing) tonnage from Leadville in 1910 was in sulphide ore. The chief sulphide ore was iron pyrite, carrying a little copper, gold, silver, and some lead. Some 7,618 tons carried lead averaging over 4½ per cent. The bulk of this iron sulphide went direct to the smelters. The tonnage of this class was 168,208 short tons, or 36.4 per cent of the total tonnage. There were also 163,218 tons, or 35.3 per cent of the total tonnage, of

[1] The assay content of the crude ore sold or treated, as reported, was 86,820,939 pounds.

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zinc-iron-lead sulphide (zinc blende; pyrite with a little galena). Sulphide ore made 71.7 per cent of the tonnage, as compared with 64.7 per cent in 1909.

The higher grade of zinc sulphide ore was shipped direct to zinc smelters without concentration. The bulk of the zinc sulphide, however, including quite a tonnage of dump ore, was separated magnetically or concentrated at Leadville, Canon City, and Denver.

Next to the sulphide ore, the second largest tonnage was of iron oxide, carrying varying quantities of manganese up to about 10 per cent and lead (generally under 4½ per cent), which was generally paid for as iron, and also silver. This tonnage amounted to 82,597 short tons, or 17.9 per cent of the total tonnage. Lead oxide ores proper amounted to 18,671 tons, or only 4 per cent of the total tonnage. Zinc carbonate and zinc silicate ores amounted to 8,059 tons (the first output of this class of ore in the history of Leadville), or 1.8 per cent of the tonnage.

Siliceous ore (principally oxide) carrying gold and silver, amounted to 21,280 tons, or 4.6 per cent of the total tonnage.

In the subdivision of ores of the State at the beginning of this chapter the siliceous and dry ores of Lake County include nearly all of the iron manganese oxide and all the iron sulphide ore (except 2,032 tons of copper ore and 7,618 of lead sulphide ore) and aggregate 254,723 tons or 55 per cent of the county tonnage.

An increased quantity of native metallic gold was mined in several of the Breece Hill mines.

Of both classes of sulphide ore, that part which was milled (nearly all zinc sulphide) amounting to 137,772 tons, or 30 per cent of all the tonnage, made 86,557 tons of gold-silver, iron, lead, and zinc concentrates (at a ratio of 1.59 to 1), from which were recovered $18,054 in gold, 276,594 fine ounces of silver, 20,920 pounds of copper, 6,825,502 pounds of lead, and 39,498,175 pounds of zinc (a small part of the lead and all the zinc being the estimated recovery from zinc concentrates and zinc residues at zinc smelters). These figures show an average recovery per ton from the crude ore of $0.13 in gold, 2.01 ounces of silver, a negligible per cent of copper, and 2.48 per cent of lead. Of those concentrates which were smelted for their zinc content, the average zinc assay of the crude ore before being treated was 24.16 per cent. In 1910, the average estimated recovery of spelter from crude ore by concentration and separation mills, followed by smelting, was 59.34 per cent of the zinc content.

The average recovery of all the concentrates showed $0.21 in gold and 3.20 ounces of silver per ton, a negligible per cent in copper and 3.94 per cent in lead. The average assay of zinc concentrates as shipped to smelters was 46.18 per cent, and the average recovery (figured as spelter) was 82 per cent of the assay content.

The tonnage of ore sent direct to smelter, the bulk of which was oxide and siliceous ores, the iron pyrite ores carrying copper, lead, gold, and silver, with some lead-zinc sulphide, and all the zinc carbonate and silicate ores, was 324,261 tons, or 70 per cent of all the tonnage. This tonnage contained $1,110,546 in gold, 3,044,053 fine ounces of silver, 3,624,237 pounds of copper, 12,424,001 pounds of lead, and 16,869.270 pounds of zinc (in terms of spelter recovered). The average theoretical assay of the smelting ore was therefore $3.42 in gold and 9.39 ounces of silver. The average theoretical assay of

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lead, copper, and zinc, based on the total tonnage smelted, has no value, as much ore did not carry lead, a greater part of the ore did not carry copper and only a small part carried zinc. However, the average assay, in terms of recovered metal, of the ore carrying copper, was 0.92 per cent of copper, of that carrying lead was 2.17 per cent of lead. The average assay of zinc in crude zinc ore shipped was 29.52 per cent. The United States Zinc Co. treats ore carrying as low as 24 per cent of zinc.

THE YAK TUNNEL.

The Yak drainage tunnel, starting in California Gulch, has been driven about 4 miles in a general eastward direction, toward the amphitheater of Big Evans Gulch and toward the Mosquito range, and 3 miles of laterals have been run. During 1910 the tunnel was driven ahead about 1,240 feet, and one branch of the heading was driven toward the Diamond claim, a distance of 3.46 miles in a straight line from the portal. A lateral was also driven to tap the Vega group. The objective point of the tunnel has apparently not yet been reached as there is no indication of stopping the work. During the year the Resurrection No. 2 shaft was reached and the mine drained and a lateral was also driven to the Dolly B. mine.

MINES REVIEW.

California Gulch, Iron Hill, Breece Hill mines, as opened by the Yak tunnel.—The main source of the ore supply from the Yak tunnel is the Silver Cord vein. A winze has been sunk from the tunnel level 600 feet, 8 levels being turned off, the bottom level being in the Cambrian quartzite. The tunnel level at this point is 600 feet below the surface. The Resurrection No. 1 mine is worked above the tunnel level, the ore being lowered for shipment. Besides the operations of the Yak Co. and its auxiliary companies, there are a number of lessees shipping ore from other mines controlled and developed by the company. The mines from which ore was shipped in 1910 were the Colonel Sellers Fraction, Comstock (or Hopemore), Favorite, Habendum, Louisville, M. N. Fraction, North Moyer, Rubie, Sedalia, Sentry, Sierra Nevada, Silent Friend, Tenderfoot, Vinnie, and White Cap. The total shipments averaged about 8,000 tons per month, the bulk of which was iron sulphides and was shipped to smelters in 1910. The zinc sulphides are treated at the magnetic separation and concentration mill of the American Zinc Extraction Co., at the mouth of the tunnel, or are shipped to Canon City and Denver.

Iron Hill.—The Iron Silver Mining Co. operates through three shafts, 500 feet, 850 feet, and 1,260 feet deep. The chief mines are the Moyer, North Moyer, and Tucson. Iron sulphides, zinc and lead sulphides, oxidized iron ores, and zinc carbonates were shipped in 1910. The territory of this mine also extends across California Gulch to Rock Hill, where zinc carbonates have been found in the Stevens mine. The annual published report of the company gives a total of 58,863 tons of an average net value of $6.62, the cost of producing which was $4.43. The total net income from ore sales and sundry revenue was $398,884, and the excess of income over operating expenses was $142,669. Attention is called in the report to the possibility of profitably mining the zinc carbonate ores, the extent and value of which have been but lately recognized. The search for

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the carbonate ores has been conducted principally from the Tucson shaft, and such ores are now being shipped from previously abandoned and supposedly worked out stopes. The sulphide ores are gradually being exhausted and a large amount of development work has not materially increased the ore reserves; to which condition is due the decrease of production.[1] The company early in 1910, and previously, sunk the Tucson shaft to a depth of 1,060 feet, at which point the shaft has penetrated 50 feet into the Cambrian quartzite. At a depth of 850 feet from surface the shaft passed into pay ore and continued therein for a distance of 55 feet. As the ore pitched rapidly to the east, the shaft was carried down 100 feet below the ore before stations were cut and levels extended to develop the pay shoot. At that time the fissures in the quartzite had not been connected with granite below or the ore deposits in the Silurian limestone above, but when the fissures were intersected at a depth of 50 feet in the Cambrian quartzite, the overlying deposits were immediately drained.[2]

The A. Y. & Minnie Co. shipped iron-lead sulphide ore to smelters, and zinc sulphide ore to separating plants. A considerable tonnage of zinc sulphide ore was removed from the A. Y. & Minnie dump to Canon City and Pueblo by the purchasers, the Empire Zinc Co. and the United States Zinc Co.

Ore from the Colonel Sellers mine was shipped to both lead and zinc smelters from the old shaft in 1910, pending the completion of a new shaft 370 feet deep and of a steel surface plant. Levels were driven at 240 and 348 feet. The Rubie mine was leased to the Empire Zinc Co., which shipped most of the ore to the company's plant at Canon City.

Zinc sulphide and iron pyrite ores were shipped from the Louisville mine through the Yak tunnel. Iron sulphide was shipped from the Adelaide, on North Iron Hill, and both iron oxide and sulphide was shipped from the Benton mine and from the Mikado-Camp Bird. The Star of the West mine was also a producer.

Breece Hill.—This hill embraces the chief mines of the gold belt.

Lessees on the Little Johnny mine of the Ibex Mining Co. continued to ship iron pyrite, and some dry siliceous oxide ore, both carrying copper, lead, gold, and silver; and also zinc sulphide, and a car or two of zinc carbonate, as well as much pure gold. A large tonnage of iron sulphide ore and a small tonnage of lead-zinc sulphide was shipped from the Garbutt mine by a lessee. The shaft on this property is down 750 feet. The Maud Hicks and the St. Crispen mines, adjoining, were also operated. A large tonnage of iron oxide ore with some sulphide ore, carrying only gold and silver, was shipped from the Breece-Iron mine. Lead oxide and sulphide ores carrying gold, silver, and copper were shipped from the Valley mine. Ore was also shipped from the Big Four, Big Six, Black Prince, Highland Mary, Humboldt, Nevada, President, St. Louis tunnel (also yielding pure gold), and the Vinnie.

Ball Mountain.—On the western lower part of Ball Mountain, north of Breece Hill, the Bald Mountain Mining Co. shipped chiefly lead sulphide from the Sunday mine, which is opened by an adit 3,000 feet long.

[1] Eng. and Min. Jour., Apr. 15, 1911, p. 755.
[2] Argall, George O., Recent developments on Iron Hill, Leadville: Eng. and Min. Jour., Jan. 29, 1910, pp. 261–266.

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South Evans Gulch—Little Ellen Hill.—The New Monarch Mining Co. maintained a large tonnage of sulphide and oxide siliceous ore, carrying more than the average content in gold and silver, as well as some copper and lead. This mine is opened by 3 shafts, the Cleveland, the deepest, being 715 feet. It is said that the bottom of the shaft is in the granite, and that drifts on this level have shown the Cleveland vein in the granite.

Carbonate Hill.—The bulk of the ore in 1910 from the property of the Western Mining Co. was lead-zinc sulphide, with some iron sulphide, and also a considerable tonnage of zinc carbonate. A very considerable amount of zinc carbonate was developed in the Wolftone, Maid of Erin, Henriette, Adams, and Mahala mines. The zinc carbonate was found to extend into the Big Chief mine and some shipments were made during the last two months of the year. Zinc carbonate was also shipped from the Greenback mine and the Morning Star mine. A large tonnage of iron oxide ore also was shipped from the Morning Star mine. Lead oxide ore was shipped from the Yankee Doodle mine, and iron oxide ore was shipped from the Catalpa, Modoc, and Shamrock mines. The Boreel Mining Co. shipped zinc sulphide ore to separation plants from the Goneabroad and Arabi Boy mines. A small tonnage was shipped from the Pyrenees mine and from the R. A. M. dump, in Graham Park.

Fryer Hill.—Iron oxide ore was shipped from the Bangkok, Chrysolite, Denver City, Dunkin, Evelyn, Little Chief, Matchless, and Seneca mines. Siliceous ore was shipped from the Little Sliver and the R. E. Lee mines. The Hayden shaft of the May Queen was under lease, and operators on this property were the first to find and ship high-grade calamine.[1] Zinc and lead sulphide and iron oxide ore was shipped by the Small Hopes Co.

Printer Boy Hill.—Lead ore was shipped from the Lillian group.

Rock Hill.—Oxide ores carrying lead were shipped from the Crescentia, the La Plata group, the Nisi Prius, and the Lecompton mines, on Rock Hill, east of Iron Hill, across California Gulch.

Iowa Gulch.—Lead ore was shipped from the Clear Grit-Ella Beeler group, from the Hellena mines, the Houston, and the Long and Derry group mines, and iron oxide ore was shipped from the Doris mine.

Downtown district.—Lead oxide ore was shipped by the Midas Co. from the Coronado mine. Iron oxide ore was shipped from the Bohn, the Cady, and the Hibschle mines.

St. Kevins or Independence district.—Along the base of the Sawatch Range, including St. Kevin and Sugar Loaf Mountain, is a mineralized region where considerable development by adits has been done and some shipments have been made. Siliceous oxide and sulphide ore, carrying lead, copper, silver, and gold, was shipped from the Dinero mine. This mine is opened by a 3,500-foot adit. The same class of ore was shipped from the Carlton-Griffin mine, also opened by an adit. Siliceous gold-silver ore was shipped from the Wilkesbarre mine.

Sugar Loaf district.—A small shipment of ore was made from the Sawatch tunnel group. A car of dump ore was shipped from the Tiger mine.

Twin Lakes district.—A small shipment was made from the Miller group, in Lackawanna Gulch. The mine is opened by two adits,

[1] Burton, Howard E., Leadville, Colo., Zinc deposits: Mines and Minerals, February, 1911, p. 436.

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one 200 feet long. A 30-stamp mill was in the course of construction in 1910, the process to be amalgamation and concentration, with cyanidation of the concentrates. The Mount Champion Gold Mining Co. was also building a mill and had mined a considerable tonnage, which was stored for future treatment.

LA PLATA COUNTY.

Mine production of gold, silver, copper, and lead in La Plata County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	6,149.38	$127,119	18,907.08	$390,844	+12,757.70	+$263,725
Silver.....do....	74,152	38,559	141,537	76,430	+ 67,385	+ 37,871
Copper.....pounds..	484	63	142	18	− 342	− 45
Lead.....do....	2,980	128	273	12	− 2,707	− 116
Total.....	.....	165,869	.....	467,304	.....	+ 301,435

There was a heavy increase in the output of both gold and silver from La Plata County in 1910. There were 6,350 short tons of ore sold or treated in 1910, as compared with 4,135 tons in 1909. The average value of the ore also increased, being $61.55 in gold and $12.04 in silver, a total of $73.59, in 1910, as compared with $30.74 in gold and $9.33 in silver, a total of $40.07, in 1909. Of the yield in 1910 the gold was 18,907.08 fine ounces, valued at $390,844; the silver was 141,537 fine ounces, valued at $76,430; and the output of copper and lead together was valued at $30, a total value of $467,304, an increase for 1910 of $301,435.

There were 8 producing mines in 1910, as against 10 in 1909. Most of the ore was shipped to smelters.

The majority of the mines are situated on the west slope of the La Plata Mountains in the drainage basin of La Plata River, near the town of La Plata, 10 miles from Hesperus, the shipping point on the Rio Grande Southern Railroad. The region is sometimes known as the California district. Prospecting for gold and silver was first begun in this region in 1878. The ores are in general of two kinds, telluride ores and gold either free or associated with pyrite.[1]

The chief producing mines in 1910 were the May Day group, Incas Nos. 1 and 2, and Valley View group. The Incas property is opened by 3 adits 145 feet, 307 feet, and 200 feet long and a shaft 85 feet deep. Crude ore was also shipped from the property of the Burnt Timber Mining & Milling Co., from the Comstock mine (the ore of which carries also 18 per cent of bismuth), from the Lucky Moon group, and from the Yellow Eye mine. Ore from the Cumberland mine, at the head of La Plata River, was treated in the 15-stamp 40-ton amalgamation and concentration plant on the property.

There was much development work done in 1910. The Tomahawk mines have been opened by a 1,700-foot crosscut adit and about 4,000 feet of drifts and raises. The company completed in

[1] Cross, Whitman, La Plata folio (No. 60), Geol. Atlas U. S., U. S. Geol. Survey, 1899, p. 12.

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1910 a 20-stamp concentration mill. During 1910 active development was made on the Neglected (or Oro Fino) mine, and ore was blocked out. This mine is located in the Oro Fino subdistrict of the California district on the east slope of the La Plata Mountains, in Gaines Gulch, a fork of Junction Creek.[1] A 7-mile aerial tramway from the mine to Hermosa, which is on the Durango-Silverton line, was begun and tests were made as to the adaptability of the cyanide process. It is reported that the cyanide process, as perfected on Cripple Creek ores, is adaptable to the La Plata County ores

LARIMER COUNTY.

Prospecting and some development work was reported from the Manhattan district, about 45 miles northwest of Fort Collins, and from the Prairie Divide district, near St. Cloud. Traces of gold are found at Manhattan. The minerals in the Prairie Divide district are zinc.

MESA AND MONTROSE COUNTIES.

There are several copper prospects in the Sindbad Valley district, Mesa County, and the La Sal district, near Paradox, Montrose County. The copper ores of this region occur as impregnations of the lighter colored sandstones immediately overlying the "Red Beds."[2] The Pyramid Mining & Milling Co. has partially completed a 150-ton leaching plant. There is a 1,400-foot adit on the La Sal mines, near Cashen.

Slag from the old Grand Junction smelter was reworked and shipped to smelters during the year.

MINERAL COUNTY.

Mine production of gold, silver, copper, lead, and zinc, in Mineral County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	5,264.41	$108,825	5,863.13	$121,181	+ 597.72	+ $12,356
Silver.....do....	891,185	463,416	773,722	417,810	− 117,463	− 45,606
Copper.....pounds..	17,401	2,262	29,031	3,687	+ 11,630	+ 1,425
Lead.....do....	9,036,816	388,583	8,246,000	362,824	− 790,816	− 25,759
Zinc.....do....	1,817,296	98,134	2,421,926	130,784	+ 604,630	+ 32,650
Total.....	.....	1,061,220	.....	1,036,286	.....	− 24,934

The value of the metallic production from Mineral County in 1910 as compared with that of 1909 showed a decrease of $24,934. There was an increase in the output of gold, copper, and zinc, but this increase was more than offset by the decreases in silver and lead.

Of the total output of 62,956 tons mined, more than one-half was milled, the remainder being sent to smelters as crude ore. The total

[1] See Emmons, W. H., The Neglected mine and near-by properties, Durango quadrangle, Bull. U. S. Geol. Survey No. 260, 1904, pp. 121-127.

[2] Emmons, S. F., Copper in "Red Beds" of the Colorado Plateau: Bull. U. S. Geol. Survey No. 260, 1904, pp. 227-228.

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average recovered value of the ore mined in the county in 1910 is represented by the following theoretical assay: Gold, 0.093 ounce; silver, 12.29 ounces; copper, 0.02 per cent; lead, 6.5 per cent; zinc, 1.9 per cent; an average value for 1910 of $16.46 per ton, as compared with $16.34 in 1909. The assay content of zinc concentrates as shipped was 41.2 per cent.

There were 9 producing mines in 1910. The largest tonnage mined was from the operations of the leasing company on the Amethyst mine, the output being in lead and zinc concentrates from the 100-ton concentration plant on the property.

The crude ore treated there averages about 5 per cent zinc and 10 per cent lead, with some silver and free gold. The silver minerals are closely associated with the siliceous gangue, and there is a consequent heavy loss of silver in the tailing. The gold occurs free and may be seen on some of the tables treating the finer sizes of pulp. The lead and zinc minerals occur free enough to warrant coarse concentration with jigs, followed by intermediate treatment on tables, finishing with slime. Quite an extensive plant is installed to save the latter. The average saving of the total value is nearly 85 per cent, the highest recovery being made on lead, next on zinc, gold, and silver, the last suffering the greatest loss. * * * The lead concentrate contains 70 per cent to 74 per cent lead; the zinc concentrate, 40 per cent to 45 per cent zinc; and the slime about 35 per cent lead.[1]

Ore from the Creede United mines was treated at the Humphreys mill with a capacity in 24 hours of 250–300 tons, but the mill was not operated continuously nor at full capacity, only about 50 tons per day being treated. The ore is practically the same as the Amethyst ore and the general process of milling is the same. Ore from the Ridge mine was also milled in the Ridge mill, with a capacity of 50 tons per day of 24 hours, but as it was run only 10 hours per day, about 20 tons per day were treated. Crude ore from the Ridge mine assays about 1.5 ounces silver, 0.01 ounce gold, 4 to 6 per cent lead, and 8 to 12 per cent zinc. The lead concentrate assays 0.16 to 0.42 ounce gold, 4.95 to 6.20 silver, about 70 per cent lead, and 7 per cent zinc. The zinc concentrate carries 50 to 56 per cent zinc, 3 per cent lead, 0.05 ounce gold, and 2 ounces silver.[2] A large tonnage of ore carrying chiefly silver and lead was shipped from the Last Chance, New York, and Volunteer mines. A large tonnage of ore of the same character was shipped from the Commodore mine, with a smaller tonnage from the Bachelor mine. Other mines from which ore was shipped were the Alpha and the Creede-Quintelle.

MONTEZUMA COUNTY.

Mining in Montezuma County is confined to the head of East Mancos River, on the west slope of the west ridge of the La Plata Mountains, this ridge being the dividing line between La Plata and Montezuma counties. The district is part of the California or La Plata district of La Plata County. The only producing property of importance in 1910 was the Doyle Consolidated mines, on which property in 1910 there was a 10-stamp concentration and cyanide plant. A larger plant is to be built in 1911.

[1] Parmalee, H. C. Zinc ore dressing in Colorado; the Creede District: Metall. and Chem. Eng., December, 1910, pp. 677–678.
[2] Op. cit., p. 680.

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OURAY COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Ouray County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	147,293.41	$3,044,825	106,224.10	$2,195,847	−41,069.31	−$848,978
Silver.....do....	345,815	179,824	414,250	223,695	+ 68,435	+ 43,871
Copper.....pounds..	984,269	127,955	620,236	78,770	− 364,033	− 49,185
Lead.....do....	2,813,932	120,999	4,004,728	176,208	+1,190,796	+ 55,209
Zinc.....do....	19,148	1,034	.....	.....	− 19,148	− 1,034
Total.....	.....	3,474,637	.....	2,674,520	.....	− 800,117

Ouray, one of the "San Juan" counties, was one of four counties in the State making a production valued at over $2,000,000, as was the case in 1909, but in 1910 it fell to third place in production of gold and fourth place in total metallic production. The yield of gold in Ouray County was $2,195,847, a decrease of $848,978, and the value of total metallic yield fell from $3,474,637 in 1909 to $2,674,520 in 1910. There was a material decrease in copper output, but a heavy increase in lead yield, and a considerable increase in silver. No zinc was recovered in 1910.

The tonnage of ore sold or treated in 1910 was 111,245 short tons, as compared with 103,864 tons in 1909. There were 24 productive mines in 1910 and 30 in 1909. The average value per ton in 1910 was $24.04, as compared with $33.45 in 1909, with $25.43 in 1908, and with $30.18 in 1907. The average value per ton in gold was $19.74, as compared with $29.32 in 1909 and with $21.02 in 1908.

The tonnage of siliceous ore increased from 101,282 short tons in 1909 to 107,260 tons in 1910; of copper ores, from 148 tons to 1,374 tons; of lead ores, from 111 tons to 2,553 tons; whereas the production of copper-lead ores decreased from 2,303 tons to 58 tons. There was no production of lead-zinc ores in 1910, as compared with an output of 20 tons in 1909.

During 1910, 102,971 tons were treated at amalgamation and cyanide mills, and the bullion contained $1,573,597 in gold, an average recovery per ton of $15.28, and 47,593 ounces of silver valued at $25,700, an average recovery of $0.25 per ton, a total value in gold and silver of $1,599,297, and an average value of $15.53 per ton. From this ore treated at amalgamation mills and from 3,535 tons sent to mills for concentration only came 12,268 tons of concentrates, yielding $593,666 in gold, an average per ton of $48.391 in gold, and 188,269 ounces of silver valued at $101,665, an average of $8.287 per ton, a total in gold and silver of $695,331, and an average of $56.678 per ton. Concentrates also contained 452,668 pounds of copper, valued at $57,489, an average value of $4.686 per ton, and 3,231,405 pounds of lead, valued at $142,182, an average of $11.59 per ton—the total value of the concentrates being $895,002, with an average of $72.954 per ton. Those concentrates which carried copper averaged 1.85 per cent of copper and those which carried lead averaged 13.17 per cent of lead. The value of both bullion and concentrates from the

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milling ore was $2,167,263 in gold, an average of $20.35 per ton, and $127,365 in silver, an average of $1.20 per ton, a total in gold and silver of $2,294,628, and an average value of $21.55 per ton of all ore milled.

Crude ore shipped to smelters amounted to 4,739 short tons, containing $28,584 in gold, averaging $6.03 per ton, and 178,388 ounces of silver valued at $96,330, averaging $20.33 per ton, a total in gold and silver of $124,914, and an average value of $26.36 per ton. There were also contained in crude ore to smelters 167,568 pounds of copper, valued at $21,281, averaging $4.49 per ton, and 773,323 pounds of lead, valued at $34,026, and averaging $7.18 per ton, a total value for the crude ore of $180,221 and an average value of $38.03 per ton. Crude ore which carried copper averaged 2.03 per cent of copper, and that which carried lead averaged 8.18 per cent of lead.

Paquin district.—There was a material increase in tonnage shipped from this district in 1910. The chief producing mines were the Neodesha and the Wedge.

Red Mountain district.—The tonnage shipped and the total value of the metallic contents from this district in 1909 and 1910 were nearly equal for the two years, though the distribution of each metal was materially different. From 2,777 tons in 1910 there were produced $4,813 in gold, 62,333 ounces of silver, 153,699 pounds of copper, and 484,963 pounds of lead, with a total value of $79,331. Copper ore was shipped from the San Antonio mine, copper-lead ore from the Genessee mine dump, and lead and copper-lead ore from the Yankee Girl mine. Lead ore was shipped from the National Belle and Oom Paul Kruger mines. Construction work was continued on the Mono-Baltic 200-ton smelting plant.

Sneffels district.—The principal producing mines of the county are in this district. In 1910 there were sold or treated 104,153 tons of ore, from which were recovered $2,150,230 in gold, 250,180 ounces of silver, 445,760 pounds of copper, and 3,436,960 pounds of lead, with a total value of $2,493,165, as compared with a total value of $3,318,623 in 1909, a decrease for 1910 of $825,458. There was a slight increase in tonnage sold or treated, but the gold content decreased $850,878, and the silver and copper content also decreased, while there was an increase in lead contents.

The output from the Camp Bird mine showed a tonnage treated in 1910 equal to that of 1909, but a greatly decreased quantity of gold in bullion recovered, and a larger tonnage of concentrates produced but carrying less gold, more silver, less copper, and more lead. The ore is sulphide, with siliceous gangue, and the process of treatment is crushing with stamps, plate amalgamation, concentration, and cyanidation of tailing. The mill comprises 70 stamps, of which 60 were operated in 1910, with a capacity of 240 tons per day. The capacity of the cyanide plant is 150 tons per day. The published report for the fiscal year ended April 30, 1910, shows that after treating 79,914 tons of ore, there remained 45,300 tons of ore broken in the stopes, with 38,600 tons estimated as blocked out, making a total of 83,900 tons of ore in reserve. From the ore treated during the fiscal year an extraction of 95.5 per cent was obtained, yielding $33.18 per ton in gold. The cost, exclusive of depreciation, was $6.93 per ton, with the addition of 47 cents for taxes and $1.55 for development. The bullion shipped during the year was valued at

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$2,647,532, making a total in the last eight years of $16,474,942. During the last year dividends were paid amounting to $866,237. The total tonnage from April 30, 1903, has been 556,618 tons and the total dividends $6,253,452. There was an increased tonnage from the Revenue mines, the product being bullion, concentrates, and crude ore, and from the Atlas mine, with an output in bullion and concentrates. Ore from the Thistledown mine was shipped crude to smelter and treated in the company's concentration mill.

Uncompahgre district.—From 12 mines in this district were produced 3,482 tons of ore, from which were recovered $34,388 in gold, 30,257 ounces of silver, 18,750 pounds of copper, and 70,946 pounds of lead, with a total value of $56,230, as compared with $69,922 in 1909.

Only a small tonnage was shipped from the American Nettie mine. Some crude ore was shipped to smelters, but the bulk of the ore from the Bright Diamond and the Iron Clad groups was treated, after November, in the 20-stamp concentration plant of the Wanakah Co. Lead ore was shipped from the Bachelor-Khedive mine. Other principal producers were the Black Girl, Eclipse-Dexter group, and El Madhi. Other producing mines were the Cascade group, Chicago, Jonathan, Mickey Breen, Morning Star, O. and N., and Uncle Sam.

PARK COUNTY.

Mine production of gold, silver, copper, lead, and zinc, in Park County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	26,699.18	$551,921	12,845.84	$265,547	−13,853.34	− $286,374
Silver.....do....	102,375	53,235	117,037	63,200	+ 14,662	+ 9,965
Copper.....pounds..	61,023	7,933	88,748	11,271	+ 27,725	+ 3,338
Lead.....do....	2,237,093	96,195	2,041,204	89,813	− 195,889	− 6,382
Zinc.....do....	366,574	19,795	659,796	35,629	+ 293,222	+ 15,834
Total.....	.....	729,079	.....	465,460	.....	− 263,619

The value of the total metallic output of Park County in 1910 was $465,460 as compared with $729,079 in 1909, a decrease for 1910 of $263,619. The tonnage sold or treated, the greater part of which went direct to smelters, was 12,329 tons, a decrease of 2,717 tons. There were 13 producing deep mines and 4 placers in 1910, against 14 deep and 2 placer mines in 1909. The placer output in 1910 was considerably less than in 1909. The average value per ton of all the ore was $36.71.

Buckskin district.—The output of this district in 1910 was valued at $2,783, as against $9,680 in 1909 and $34,098 in 1908. The chief producer was the Paris mine, the ore of which was treated in a 50-ton amalgamation mill. A shipment of zinc ore was made from the Nelson mine.

Consolidated Montgomery district.—The value of the output from this district in 1910 was over three times that of 1909. The Colorado Gold Mining & Smelting Co. completed its 150-ton semipyritic mat-

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ting plant at Alma in July, 1910, and operated it for a time on ores from its own mines, the Atlantic, the Pacific, and the Kentucky Belle, and from its leases on other mines, as well as on some custom ore from other properties, chief of which was the Dolly Varden mine. Small shipments to outside smelters were made from the Ling group and the Morning Star mines.

Horseshoe district.—An increased tonnage of lead and zinc ore was shipped from the Chance-Hilltop mines. The Platte River Placer Co. operated the most important hydraulic mine in the county. There was also an output from the Winette placer in this district.

Mosquito district.—There was a material decrease in the output of this district in 1910, and the total value represented about 52 per cent of the county yield, as compared with 75 per cent of yield in 1909. There were 5 producing deep mines in 1910.

Operators of the London mine, at the head of Mosquito Creek, on the ridge between Leadville and Alma, continued to ship siliceous ore, carrying a high content of gold and silver, copper, and lead as well. Lead ore was shipped from the Hock Hocking, the Harrisburg & Gettysburg group, and the Wheeler mines. A small shipment of gold-silver ore was shipped from the Winnie mine.

Sacramento district.—There was no output in this district in 1910.

Tarryall district.—A car or two of ore was shipped from the Reliance mine.

PITKIN COUNTY.

Mine production of gold, silver, copper, lead, and zinc, in Pitkin County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	36.04	$745	31.25	$646	− 4.79	− $99
Silver.....do....	700,038	364,020	477,813	258,019	−222,225	−106,001
Copper.....pounds..	26,092	3,392	24,843	3,155	− 1,249	− 237
Lead.....do....	13,143,210	565,158	13,408,250	589,963	+265,040	+ 24,805
Zinc.....do....	34,741	1,876	.....	.....	− 34,741	− 1,876
Total.....	.....	935,191	.....	851,783	.....	− 83,408

There was a decrease in the total value of the output of Pitkin County mines in 1910, the only metal showing an increase being lead. The tonnage sold or treated in 1910 was 89,037 short tons, as compared with 112,448 tons in 1909.

Pitkin County remained fifth in rank as regards the production of silver, but maintained its place as second to Lake County in the production of lead.

The quantity of silver reported from lead ores was 294,453 ounces, and from dry ore, which carried less than 4.5 per cent of lead, was 183,360 ounces. The average yield in silver and lead of all the ore treated or sold was, silver, 5.37 ounces per ton, and lead, 7.52 per cent.

Roaring Fork (Aspen) district.—With the exception of several cars of concentrates from Ashcroft, the entire output of this county was from Aspen. A very heavy tonnage, though less than in 1909, was mined from the Smuggler mine, the greater part of which was treated

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at the Smuggler concentration mill. During the year the Free Silver shaft was successfully unwatered, for the fourth time in two years, with the aid of deep-sea divers and electric pumps. The Free Silver shaft was started in 1894 to reach the Mollie Gibson and Smuggler lodes at a depth of 1,500 feet and was completed to a depth of 1,200 feet in 1897, but was closed down shortly thereafter and until recently has been filled with water. Ore from the Montrozonna mine was also concentrated. There were large tonnages shipped from the Aspen, Durant, Spar group, Mineral Farm group, and Millinee group mines. Other mines from which ore was shipped were the Argentum-Juniata, Aspen Fraction, and Pride of Aspen.

Ashcroft (or Columbia) district.—The Tam O'Shanter-Montezuma Co. operated its 100-ton concentration plant during the latter part of the year, making a lead concentrate, which was shipped, and a zinc middling, which was stored for retreatment. The lead concentrate carries also silver and a little copper and gold.

Lincoln district.—No production was made from the mines of this district, which is in the southeast corner of the county.

RIO GRANDE COUNTY.

The only property upon which any work was done in Rio Grande County in 1910 was the Golconda mine, near Summitville.

ROUTT COUNTY.[1]

The total metallic yield in 1910 from Routt County was valued at $6,715, as compared with $5,153 in 1909 and with $5,865 in 1908. The output in 1910 was all placer gold (ranging in fineness from 0.642 gold and 0.349 silver in Hahns Peak district to 0.954 gold and 0.050 silver in the Lay and the Four Mile districts), with a total of 323.58 fine ounces of gold, valued at $6,689, and 48 fine ounces of silver, valued at $26.

Four Mile district.—This district is in Colorado, near the Wyoming line, near Baggs, Wyo. The Timberlake Mining Co. was the principal placer property in this district, working bench gravels by hydraulicking. Sluicing operations on the Nelson Bar placer and one other property yielded moderate quantities of placer bullion.

Hahns Peak district.[2]—Moderate quantities of gold were recovered by hydraulicking on the Leckenby-Brown (or Blackburn-Nova Scotia) placers, and by sluicing on the McIntosh placer, near Hahns Peak.

No ore was shipped from the Royal Flush deep mine, but much development work was done, work being continuous throughout the year.

Lay district.—Some gold was recovered from the Jack Rabbit placer, which is reported to be worked by a dredge.

Slater district.—Some development work was done on the mines near Slater, Colo. The properties lie immediately on the Colorado-Wyoming line.

Yarmony district.—A copper prospect was opened here in 1910, a 350-foot incline shaft being driven. It was reported that a considerable tonnage of ore was blocked out.

[1] Four Mile and Lay districts are included in the new Moffat County, final organization of which did not take place until 1911.

[2] See George, R. D., and Crawford, R. D. The Hahns Peak region, Routt County, Colo.: First Report, 1908, Colorado Geol. Survey, 1909, pp. 189-229.

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SAGUACHE COUNTY.

There were 296 tons of ore shipped from Saguache County in 1910, as compared with 192 tons in 1909, and the total value of output in 1910 was $11,407, as compared with $6,450 in 1909. There was a decrease in the output of gold, but increased yields of silver, copper, and lead.

Alder district.—There was a small shipment of lead ore from this district.

Baca Grant (or Crestone) district.—There were no shipments from this district in 1910, but there is some promise of the reopening of several properties.

Embargo district.—A small shipment of lead ore was made from the Comet mine.

Kerber Creek district.—This district lies near the town of Bonanza. Lead ores were shipped from the Antoro, Bonanza, and Mogul mines. The Rawley mine was actively developed during the year, about 1,100 feet of tunnels and drifts being driven and ore being put on the dump.

SAN JUAN COUNTY.

Mine production of gold, silver, copper, lead, and zinc in San Juan County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	33,053.04	$683,267	34,371.74	$710,527	+ 1,318.70	+$27,260
Silver.....do....	793,637	412,691	782,250	422,415	− 11,387	+ 9,724
Copper.....pounds..	1,653,192	214,915	1,208,496	153,479	− 444,696	− 61,436
Lead.....do....	9,085,068	390,658	10,688,386	470,289	+1,603,318	+ 79,631
Zinc.....do....	786,518	42,472	3,781,259	204,188	+2,994,741	+161,716
Total.....	.....	1,744,003	.....	1,960,898	.....	+216,895

The value of the metallic production of San Juan County in 1910 showed an increase of $216,895 over that of 1909, the only decrease in value being in the production of copper.

San Juan County, as in 1908 and 1909, ranked second to Lake in the production of copper, and third in the output of lead.

There were 53 producing properties in 1910 as against 40 in 1909, and the tonnage produced was 206,272 short tons as against 187,041 in 1909.

The siliceous ore output was 178,565 short tons, as compared with 145,434 tons in 1909. The copper ore production decreased from 1,015 tons to 157 tons, the lead ore decreased from 37,767 tons to 2,436 tons, and the copper-lead ore decreased from 2,825 tons to 1,999 tons. Ores, the contents of which were mainly valuable for lead and zinc, amounted to 23,115 tons in 1910, as against no ore of such classification in 1909, although there were zinc concentrates produced in 1909 from ore which was more valuable for the gold and silver content, the zinc recovered representing only a small content in the crude ore. In 1910 also there was much ore of chief value in gold and silver, from which much zinc was recovered in concentrates.

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The average total metal value per ton of siliceous ore was $8.14, of which $3.77 was gold; of copper ores, $30.34, of which $15.33 was gold; of lead ores $59.55, of which $6.81 was gold; of copper-lead ores, $74.85, of which $1.60 was gold; and of lead-zinc ores $8.96, of which $0.63 was gold. During 1910 there were treated at amalgamation and cyanide mills 131,593 tons, and the bullion contained $288,448 in gold, an average recovery per ton of $2.192, and 5,752 ounces of silver valued at $3,106, an average recovery of $0.024 per ton, a total in gold and silver of $291,554, and an average value of $2.216 per ton. From the ore treated at amalgamation mills and from 68,627 tons sent to mills for concentration only, a total of 200,220 tons (97.1 per cent of all the tonnage mined), were produced 32,713 tons of concentrates, yielding $385,431 in gold, an average of $11.78 per ton, and 370,265 ounces of silver valued at $199,943, an average of $6.11 per ton—a total in gold and silver of $585,374 and an average value of $17.89 per ton. These concentrates also carried 997,273 pounds of copper, or an average of 1.52 per cent and an average value of $3.87 per ton; of lead, 8,571,423 pounds, or an average of 13.10 per cent and an average value of $11.53 per ton; and of zinc, 3,743,341 pounds, or an average of 5.72 per cent and an average value of $6.18 per ton—a total average value per ton in all five metals of $39.47.

There were produced from the ore to both classes of mills, 200,220 tons, from both bullion and concentrates, $673,879 in gold, an average of $3.366 per ton, and $203,049 in silver, an average of $1.014 per ton, a total in gold and silver of $876,928, and an average value per ton of $4.38 for all ore milled, and copper, lead, and zinc to the value of $705,937, an average of $3.53 per ton—a total value for all ore milled of $1,582,865, and an average value per ton of $7.91, as against $7.48 in 1909.

Crude ore shipped to smelters amounted to 6,052 tons, containing $35,768 in gold, and averaging $5.91 per ton; 406,218 ounces of silver valued at $219,358, averaging $36.25 per ton—a total in gold and silver of $255,126, and an average of $42.16 per ton; and also containing 211,223 pounds of copper, 2,116,963 pounds of lead, and 37,918 pounds of zinc, the three combined valued at $122,019, or an average of $20.16 per ton, a total average value per ton for the smelting ore of $62.32.

The average value in 1910 in gold, silver, copper, lead, and zinc of the entire tonnage of 206,272 tons was $9.50 per ton, of which $3.44 was for gold, $2.05 for silver, $0.74 for copper, $2.28 for lead, and $0.99 for zinc.

Animas district.—This district includes the mines in the immediate vicinity of Silverton and south and east of Animas River from Silverton to the town of Middleton. There were 37 producing mines, as compared with 31 in 1909. The Hercules was the principal producer in 1910, the mine furnishing a large tonnage to the 40-stamp plate-amalgamation and concentration mill. The ore as mined is a dry sulphide ore, the product from the mill being bullion and a lead concentrate carrying lead, copper, most of the silver, and over two-thirds of the gold. The Iowa-Tiger property was a large producer, the ore going to a 150-ton mill for concentration only. Next in point of tonnage were the Silver Lake mines, the ore of which—gold and silver bearing sulphides of copper and lead—was treated in the 200-ton unit of the Silver Lake mill. Gold and silver bearing

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sulphides of lead, copper, and zinc from the Aspen mine were milled in the 100-ton unit of the Silver Lake mill. A prominent producer in 1910, which was unproductive in 1909, was the Intersection Group. Heavy iron sulphides carrying gold and silver were treated in a 5-stamp amalgamation and concentration mill, the tailings being impounded for future cyanidation. Ore from the North Star was milled in an amalgamation and concentration mill, and ore from the Green Mountain and the Old Hundred mines was concentrated. Large shipments of crude ore were made from the Dives, Highland Mary, and Shenandoah mines, and shipments were made from the Trilby and the Pride of the West mines. Other mines producing small tonnages were the Arpad, Brooklyn, Buffalo Boy Group, Champion, and Queen City.

From the district there was sold or treated in 1910 a total of 107,534 tons, from which were recovered $260,112 in gold, 569,118 ounces of silver, 713,435 pounds of copper, 6,720,004 pounds of lead, and 180,223 pounds of zinc, with a total value for the five metals of $963,454. In 1909 the tonnage was 85,629 tons, carrying $228,204 in gold, 612,525 ounces of silver, 918,985 pounds of copper, 6,948,884 pounds of lead, with a total value for the four metals of $964,987.

Eureka district.—This district includes all the mines to the north of Silverton, extending to the northern boundary of San Juan County, and including Chattanooga, Gladstone, Animas Forks, and Eureka. There were 16 producing mines in 1910 as against 8 in 1909. There are several mills of large capacity in this district. Chief among these is the 40-stamp, 100-ton plate-amalgamation and concentration mill of the Sunnyside mines, the ore of which yields three-fourths of its gold contents and a small quantity of silver to the amalgamating plates, the remainder being recovered as lead and lead-zinc concentrates. The Gold King 80-stamp, 300-ton amalgamation and concentration plant was operated at partial capacity for about four months by the company, and for a shorter period by lessees, on ore from the Gold King mines, the bulk of the contents being recovered in the concentrates. Of the 100 stamps of the Gold Prince mill at Animas Forks 40 stamps, with the accompanying concentration tables, were operated for five months on ore from the Gold Prince mine, the product being gold-silver bullion, and lead and lead-zinc concentrates. The Ledge Consolidated mill, at Chattanooga, for concentration only, was operated from May to December on ore from the Silver Ledge mine, the product being lead and lead-zinc concentrates, carrying copper, gold, and silver, the chief value being, however, in the lead and zinc. The mine and 50-ton mill of the Kittimac mines were operated part of the year. Ore, the contents of which were more valuable for lead and zinc than for other metals, was treated in the Vermillion mill. The principal mines producing crude shipping ore only were the Bonner, the Congress, and the Esmeralda.

From the district there were sold or treated in 1910 a total of 98,633 tons, from which were recovered $444,450 in gold, 210,289 ounces of silver, 490,314 pounds of copper, 3,965,406 pounds of lead, and 3,601,036 pounds of zinc, with a total value for the five metals of $989,210. In 1909 the tonnage was 101,412 tons, carrying $455,063 in gold, 181,112 ounces of silver, 734,207 pounds of copper, 2,136,184 pounds of lead, and 786,518 pounds of zinc, a total value of $779,016.

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SAN MIGUEL COUNTY.

Mine production of gold, silver, copper, lead, and zinc in San Miguel County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	110,539.34	$2,285,051	120,685.61	$2,494,793	+10,146.27	+$209,742
Silver.....do....	1,344,152	608,959	1,144,050	617,787	− 200,102	− 81,172
Copper.....pounds..	501,285	65,167	544,189	69,112	+ 42,904	+ 3,945
Lead.....do....	4,941,370	212,479	7,791,841	342,841	+2,850,471	+ 130,362
Zinc.....do....	804,296	43,432	2,193,981	118,475	+1,389,685	+ 75,043
Total.....	.....	3,305,088	.....	3,643,008	.....	+ 337,920

The total value of the metallic production of San Miguel County in 1910 was $3,643,008, an increase of $337,920. There were increased tonnages mined in all the districts except the Mount Wilson district, from which there was no production as against a small yield in 1909. With the exception of a material decrease of silver and a nominal decrease of copper in the Upper San Miguel district, there were increases of metallic contents in all the districts in which ore was mined.

The output from 43 deep mines was 481,000 short tons, as compared with 423,609 tons from 39 mines in 1909. The average value per ton in 1910 was $7.57, as compared with $7.80 in 1909, with $8.08 in 1908, with $9.08 in 1907, with $10.31 in 1906, and with $9.58 in 1905. The average value per ton in gold in 1910 was $5.19 and in silver $1.28.

The tonnage of siliceous ore produced amounted to 471,849, being 98 per cent of the entire output. Practically all the gold and silver produced came from this class of ore. The output of lead ores was 1,123 tons, of copper ores 24 tons, and of lead-zinc ores 8,004 tons.

San Miguel County again ranked second to Teller in tonnage mined, and ranked second to Teller in value of gold produced. In silver yield San Miguel County also maintained second place, with Lake County leading. In total value of metals produced San Miguel stood third, with Teller first and Lake second, while Ouray fell from third to fourth place.

During 1910 there were treated at amalgamation and cyanide mills 452,240 short tons, or 94 per cent of all the tonnage mined; and the bullion yielded $1,803,041 in gold, an average of $3.99 per ton, and 304,723 ounces of silver, valued at $164,550, or an average of $0.36 per ton, a total value in gold and silver of $1,967,591, or an average value of $4.35 per ton, as compared with $4.37 in 1909 and with $4.50 in 1908. Therefore, 63 per cent of the gold and silver produced in the county from all sources was recovered as bullion. From the ore treated at amalgamation and cyanide mills, and from 27,364 tons sent to mills for concentration or separation only, a total of 479,604 short tons, or 99.7 per cent of the total tonnage, there were produced 32,251 tons of concentrates, valued at $682,851 in gold, an average of $21.173 per ton, and 781,995 ounces of silver, valued at $422,277, an average of $13.093 per ton, a total in gold

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and silver of $1,105,128, and an average of $34.27 per ton, as compared with $49.29 per ton in 1909 and with $24.34 in 1908. There were also recovered from the concentrates 529,633 pounds of copper, valued at $67,263, or an average of 0.82 per cent, and an average value of $2.09 per ton; 7,292,248 pounds of lead, valued at $320,859, or an average of 11.3 per cent, and an average value of $9.95 per ton; and 2,193,981 pounds of zinc, valued at $118,475, or an average of 3.4 per cent, and an average value of $3.67 per ton, a total average value for the concentrates of $49.98 per ton.

There were produced from all milling ore—479,604 tons—$2,485,892 in gold, from both bullion and concentrates, an average of $5.183 per ton, and 1,086,717 ounces of silver, valued at $586,827, or an average of $1.224 per ton, a total in gold and silver of $3,072,719, and an average of $6.407 per ton; and also copper, lead, and zinc, with a combined value of $506,597, or an average of $1.056 per ton, a total average recovered value for all milling ore in gold, silver, copper, lead, and zinc of $7.463 per ton.

Crude ore shipped to smelters amounted to 1,396 tons and contained $8,901 in gold, averaging $6.38 per ton; 57,333 ounces of silver, valued at $30,960, averaging $22.18 per ton, a total in gold and silver of $39,861, and an average value per ton of $28.56; and also contained 14,556 pounds of copper, averaging 0.52 per cent, and 499,593 pounds of lead, averaging 17.89 per cent, with a combined value for the two base metals of $23,831, an average value of $17.07 per ton—a total average value for the ore smelted of $45.63 per ton.

Crude ore and concentrates combined shipped to smelters amounted to 33,647 tons, containing $691,752 in gold, an average of $20.56 per ton; 839,328 fine ounces of silver, valued at $453,237, an average of $13.47 per ton; and in base metals 544,189 pounds of copper, 7,791,841 pounds of lead, and 2,193,981 pounds of zinc, the three metals valued at $530,428, or an average of $15.76 per ton—a total average value of $49.79 per ton.

Upper San Miguel district.—The output from this district in 1910 was 429,231 tons of ore, and $2,294,542 in gold, 992,452 fine ounces of silver, 488,196 pounds of copper, 6,607,352 pounds of lead, and 2,193,981 pounds of zinc. The total value of the production was $3,301,665, as compared with $3,177,648 in 1909, and $3,209,561 in 1908. Three large companies, the Liberty Bell, the Smuggler Union, and the Tomboy mines, furnished over 95 per cent of the tonnage and considerably over 90 per cent of the total production of the district, as in 1909, 1908, and 1907.

From the Argentine mine of the Tomboy Gold Mines Co. (Ltd.) a larger tonnage was treated than in 1909. The 350-ton reduction plant comprises 60 stamps with amalgamation plates, Frue vanners, Wilfley tables, and a roasting and magnetic separation plant, the latter for the removal of iron sulphides from the zinc concentrate. For the year ending June 30, 1911, the company reports that 110,560 tons was sent to the mill, as compared with 102,000 tons the year before. By amalgamation and cyaniding, bullion worth $488,304 was saved, as compared with $487,486; the dressing plant produced lead and zinc concentrates that sold for $328,060, as compared with $332,970. * * * During the year 3,555 feet of development was done, and on June 30 the reserve was estimated * * * at 444,600 tons, as compared with 400,000 tons a year ago. The con-

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centrating plant has been improved in several points of detail, with the result that a larger amount of ore can now be treated and cleaner lead and zinc concentrates obtained.[1]

The tonnage output from the Smuggler-Union mines also increased in 1910. The ore is mainly sulphide with siliceous gangue and the process of treatment at this property is crushing by stamps, amalgamation, concentration, and cyaniding of the sands in the tailings. The plant includes one 80-stamp mill and one 60-stamp mill, with a capacity of 600 tons daily, 1 cyanide plant, and 1 canvas plant. The Liberty Bell mine also produced an increased tonnage in 1910. The ore from this mine is both sulphide and oxidized (chiefly sulphide), and the process of treatment is crushing in cyanide solution, amalgamation, concentration, settling, filtering, and precipitation by zinc. The annual report of the Liberty Bell Co. for the year ended September 30, 1910, shows that during the year, from its mine at Telluride, Colo., there were 133,899 tons of ore milled, from which were recovered in mill bullion $511,410, cyanide products worth $318,045, and concentrate (2,503 tons) to the value of $125,498, other incidental receipts making a total of $988,604. The recovery of gold was 57 per cent in mill bullion, 8 per cent in concentrate, 28 per cent in cyanide products, a total of 93 per cent recovery, with a loss of 7 per cent in tailing. The total recovery of silver contents was 60 per cent.[2]

From the Black Bear mine there was milled in the 20-stamp amalgamation and concentration plant a considerable tonnage of ore, which carried gold, silver, copper, lead, and zinc, the value of the product being chiefly in lead and zinc in concentrates, although the gold recovered on the plates and in concentrates was about equal to the gross value of the zinc recovered. Bullion and concentrates were produced from the Contention mine and bullion from the Gold King. Crude ore and concentrates were shipped from the Japan-Flora group mines and from the 45-ton concentrating plant on the property. Lead concentrates from one month's operation of the 50-ton concentrating plant of the Lewis mine were sent to smelter. Other producing mines were the Bear Creek, Columbia, Humboldt, Kitty Mack, La Junta, Modena, and Nellie.

Iron Springs district.—This district embraces the mines near Ames and Ophir. An increased tonnage and increased yield of metals was made in 1910. From 51,019 tons were recovered $159,332 in gold, 148,986 ounces of silver, 54,400 pounds of copper, and 1,172,181 pounds of lead, with a total value of $298,269, as compared with $122,565 in 1909.

There were 17 producing mines in this district, as against 15 in 1909. A large tonnage from the Alta mines was treated at the 150-ton concentration plant on the property. An increased tonnage from the Butterfly-Terrible mines was treated in the company's amalgamation and concentration mill. Increased shipments of lead ore were made from the Carbonero group. A small tonnage was produced from the Carribeau mine. The output from the Favorite mine was crude lead ore, and bullion and lead concentrates from the 20-stamp, 50-ton amalgamation and concentration plant. Bullion was shipped from the Suffolk mill.

Lower San Miguel district.—The total metallic yield from this district near Sawpit and Placerville was valued at $17,388, as com-

[1] Min. Mag. (London), October, 1910, p. 296.
[2] Min. and Sci. Press, May 27, 1911, p. 742.

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pared with $3,769 in 1909, and with $14,161 in 1908. Lead ore was shipped from the Gertrude and Noon mines, and ore carrying chiefly gold and silver was shipped from the Lizzie G. mine. Milling ore from the Florence L., the Golden Rose, and the Thomas group mines was treated in small plants.

Mount Wilson district.—No output was made from the mines of this district.

SUMMIT COUNTY.

Mine production of gold, silver, copper, lead, zinc, and associated metals in Summit County, Colo., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	21,902.56	$452,766	17,839.05	$368,766	− 4,063.51	−$84,000
Silver.....do....	99,763	51,877	152,250	82,215	+ 52,487	+ 30,338
Copper.....pounds..	3,839	499	21,740	2,761	+ 17,901	+ 2,262
Lead.....do....	3,559,278	153,049	5,015,409	220,678	+1,456,131	+ 67,629
Zinc.....do....	5,798,167	313,101	5,542,685	299,305	− 255,482	− 13,796
Total.....	.....	971,292	.....	973,725	.....	+ 2,433

Summit County is the foremost placer producing area in Colorado, and in 1910, as in 1909 and 1908, the production of zinc was second only to that of Lake County. There was a decrease in the production of gold in 1910, both from placers and deep mines, and there was also a decreased yield of zinc.

There were 20 producing deep mines in 1910, as compared with 27 in 1909, and the tonnage sold or treated was 47,040 tons, as compared with 31,098 in 1909, with 14,631 in 1908, and with 25,127 tons in 1907. There were 9 placer mines, 1 operated by drifting and hydraulicking, 1 by hydraulicking, and 3 by sluicing; and there were 4 dredges.

There was a decrease in output of gold in 1910 from deep mines of $25,844, and from placer mines of $58,156, making a total decrease in gold of $84,000. The output of silver from deep mines showed an increase of 53,321 ounces, while that from placer mines decreased 834 ounces. The silver from deep mines was from lead-zinc, siliceous, lead, and copper-lead ores, there being no silver reported from zinc ores in 1910.

Breckenridge district.[1]—Breckenridge district includes Bevan, Minnesota, and Union districts, and includes the mines near Breckenridge, on French Gulch and on Blue and Swan rivers, and includes all the placers of the county. The value of the total output of gold, silver, copper, lead, and zinc from both deep and placer mines was $755,356, or almost 78 per cent of the county yield.

In the Bevan district the chief property is the Wellington mines. An increased tonnage of lead-zinc and zinc ore was mined, the greater part of which was milled at the company's 100-ton wet-concentration mill, yielding a shipping product of a lead concentrate, a zinc concentrate, and a zinc middling. Much of the zinc middling was

[1] See Ransome, F. L., Geology and ore deposits of the Breckenridge district, Colo.: Prof. Paper U. S Geol. Survey No. 75, 1911.

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stored, and the erection of a roasting and magnetic separator plant was in preparation to treat this product at the mine. The mill is electrically operated. Lead ore was shipped from the Dunkin and Standard mines. This district includes the placer properties of the Reliance Gold Dredging Co. and of the French Gulch Dredging Co., both of which dredges were operated during the year, but with a decreased output. The Reliance dredge is of the double lift, open-connected type, with buckets of a capacity of 9 cubic feet. Both are operated by electricity. In the Minnesota district there were three producing deep mines, none of which yielded a very large tonnage. These were the Arctic, the Boss group, and the Silver King mines.

In the Union district, the Colorado Gold Dredging Co. operated 2 dredges, 1 in the Blue River and 1 in the Swan district. Only one of the two dredges was in operation steadily. These dredges are of the Bucyrus open-connected type, with buckets of a capacity of 9½ cubic feet. The power used is electricity. There was an increased output from the Snyder placer, on Swan River. This mine is operated by drifting and hydraulicking.

Consolidated Tenmile district.—This district includes Frisco, Kokomo, and Robinson. The total production was about nine times that of 1909, the output coming chiefly from one mine, the Robinson (or International), at Robinson. A large tonnage of lead-zinc ore from this mine was treated by the Wilson Mining Co. at its mills, one of which, at Leadville, served as a testing plant until the other, at Robinson, was completed.

The ore is a mixed zinc-lead-iron sulphide, with some siderite, in a siliceous gangue. The average composition is: Silica, 11 per cent; iron, 23.6 per cent; lead, 10.4 per cent; zinc, 14.8 per cent; lime, 4 per cent; sulphur, 35.6 per cent; silver, 7 ounces per ton; and gold, 0.07 ounce. The principal steps in the process of treatment are crushing and grinding, drying, roasting, magnetic separation, and wet dressing. The daily capacity of the mill is 125 tons. In this plant, the iron is first removed by magnetic separation and the zinc-lead product then separated by wet concentration. (At the Wellington mill, at Breckenridge, the reverse is the case, the lead and zinc being first separated, there being a third product of zinc-iron middlings, from which it is proposed to remove the iron by roasting and magnetic separation.) The products from the Wilson mill are magnetic iron concentrate, sold for flux, a zinc concentrate, a lead concentrate, and also a tailing, which carries about 9 per cent of zinc and 1.2 per cent of lead, and amounts to 15 to 18 per cent of the ore treated. The mill is electrically operated throughout.[1] The Felicia Grace, Michigan, and Roswell-Sprague mines, each produced several cars of iron ore carrying gold, silver, copper, and lead. The Kimberley-Wilfley mines and mill, a roasting, magnetic-separation, and wet-concentration plant, were not operated in 1910.

Snake River (Argentine, Montezuma,[2] and Peru) district.—The New Penn mine's 100-ton concentration plant, near Argentine, was operated for eight months on a considerable tonnage of ore from the Pennsylvania mine, the output, a lead concentrate, being shipped to Salida.

[1] Parmalee, H. C., Zinc ore dressing in Colorado: Metall. and Chem. Eng., February, 1911, pp. 91–95.
[2] See Patton, Horace B., The Montezuma mining district, of Summit County, Colo.: First Report, 1908, Colorado Geol. Survey, 1909, pp. 104–144. Also Spurr, Garrey, and Ball, Prof. Paper U. S. Geol. Survey No. 63, 1908, pp. 69, 104.

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Small tonnages from the Silver Wave, Silver Princess, and Wewissa mines, near Montezuma, were shipped or treated in 1910. Preparatory to reopening, some retimbering was done on the adits and drifts of the St. John mines, at Montezuma, and a 600-ton wet-concentration mill was built for the purpose at present for treating the large dumps of the property. A considerable tonnage of this dump material was treated in 1910, only a car or two of the lead and zinc concentrate produced being shipped in 1910, the remainder being held for re-treatment. Several small shipments of lead ore from Montezuma were made in 1910. The Colorado-Toledo mine, on Collier mountain, at Montezuma, was operated during the entire year, and much development work was done. The mine is opened by an adit 3,000 feet long. The ores are mixed sulphides of lead, zinc, gold, and silver. The erection of a 200-ton wet-concentration mill was almost completed in 1910. The product will be lead concentrate and lead-iron concentrate for shipping, iron-zinc middling, which is to be re-treated, and a zinc product, which may or may not be marketable.[1]

TELLER COUNTY.

Production of gold and silver from Teller County, Colo., ores in 1909 and 1910.

Metal.	1909.		1910		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces.	554,893.81	$11,470,673	532,233.99	$11,002,253	22,659.82	$468,420
Silver.....do....	60.017	31,209	54,263	29,302	5,754	1,907
Total.....	.....	11,501,882	.....	11,031,555	.....	470,327

In 1910 there was recovered from ore from Teller County (Cripple Creek mining district) by mills and smelters, from crude ore and dump ore, from the treatment of tailings of previous years, of tailings from operations of 1910, from slags, slimes, "cleanup" of mills, and from stolen bullion and ore, 532,233.99 fine ounces of gold, valued at $11,002,253, a decrease, as compared with the yield in 1909, of $468,420.

From the viewpoint of the mines alone, as reported from 83 properties, from mine ore and old dumps, 668,941 short tons of material were sold or treated, which averaged per ton 0.7644 ounce gold, valued at $15.80 (or $15.29 at $20 per ounce)—a total content of 511,350.89 fine ounces, valued at $10,570,561 (or at $10,227,018 at $20 per ounce). In 1909 the number of mines was 83 and the average per ton was 0.9593 ounce per ton, or $19.83, and in 1908 there were 96 producing properties and the average per ton was 0.9922 ounce, or $20.51. This decrease in the average value for 1910 is the direct result of a large tonnage of dump and mine ore of low-grade material treated by the Stratton's Independence, Portland, and other mills in the Cripple Creek district, as well as the working of other dumps, by lessees.

As in 1909, 6 or 8 of the large mines, worked on company account, produced over one-half the tonnage and about one-half of the out-

[1] Le Wald, W. B., The Colorado-Toledo mill: Min. and Sci. Press, Feb. 18, 1911, pp. 261-262.

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put, the remainder being mined by lessees, both as large leasing companies or as individuals. With few exceptions the conditions were as in 1909; several of the larger properties were operated with a reduced force on the upper levels only, and waited for their mines to be unwatered by the drainage tunnel, as it was considered better economy to shut down the pumps on these lower levels than to keep up a large tonnage with the heavy cost of pumping charged against the cost of extracting the ore.

THE CRIPPLE CREEK DRAINAGE OR ROOSEVELT TUNNEL.

The theories, assumptions, and all available data as to the source of the underground water in the Cripple Creek volcanic vent, the fall of water, its fluctuations, and the effect of pumping and of previous tunnels, with the history of each undertaking up to February, 1905, and a review of the feasible sites for the new tunnel, have been fully compiled in the United States Geological Survey report on the geology and the gold deposits of the Cripple Creek district.[1] The site for the portal finally accepted was according to the Gatch Park plan, starting at an elevation of about 8,020 feet, at 770 feet below the El Paso tunnel, a distance of 14,550 feet to the El Paso shaft, and gaining a depth of 740 feet. After much desultory work had been done in 1907 by the Tunnel company and by contractors, when a total of 1,500 feet was driven, the contract was awarded, in January, 1908, to Mr. A. E. Carlton. From that time the work progressed steadily from the portal and also from the headings, north and south of an intermediate shaft, 7,975 feet from the portal and at an elevation of the shaft collar of 8,743 feet, its depth of tunnel grade being 685 feet. This shaft was started August 16, 1907, and finished September 16, 1908.[2] At the close of 1908 there had been completed in all three headings a distance of 4,872 feet, all of it in Pikes Peak granite. In 1909 the tunnel was advanced steadily and was in over 12,000 feet at the close of the year, no heavy flow of water having been encountered, one small watercourse giving off about 100 gallons per minute. In December, 1910, the tunnel was 15,640 feet long, had entered the breccia area, and had passed 1,190 feet beyond the El Paso shaft, the first to be reached on the line of the tunnel. The tunnel and the shaft of the El Paso had been connected by a crosscut, upraise, and churn-drill hole, and about 1,000 gallons per minute were flowing from the tunnel alone, as well as a larger flow released November 19 from the El Paso shaft. The contractors were then authorized to drive 200 feet more, unless a flow of 2,000 gallons per minute was obtained at that distance. The cost of the tunnel has been $28 per foot and the total amount subscribed by the mining companies of Cripple Creek was $550,000.[3]

At the close of the year the lowering of the water was noticed in many of the mines—as in the Granite, the Elkton, and the Portland—and the long-flooded levels of the El Paso were beginning to be unwatered. Since the end of 1910 the Tunnel Co. drove a 540-foot crosscut to cut the C., K. & N. vein, 500 feet east of the

[1] Lindgren and Ransome, Geology and gold deposits of the Cripple Creek district: Prof. Paper U. S. Geol. Survey No. 54, 1906, pp. 233–251.
[2] Herrick, R. L., Roosevelt Tunnel: Mines and Minerals, April, 1909, pp. 387–391.
[3] Eng. and Min. Jour., Dec. 3, 1910, p. 1104.

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main El Paso shaft. Still later the decreased pressure of the underground water had so lessened the speed of the subsidence of the water that subscriptions were being raised to drive the tunnel 1,200 feet farther into Beacon Hill.

MILLS AT COLORADO CITY.

In 1910 only 5 per cent of the ore from Cripple Creek was treated at smelters, 95 per cent being treated at local mills and mills at Colorado City. In addition a considerable tonnage of tailing of previous years' operations were treated by the Portland and the Colorado mills at Colorado City.

The valley mills adjoining Colorado City are the Golden Cycle, a roast-cyanide plant, of about 1,000 tons capacity daily; the two plants of the United States Reduction & Refining Co., the Standard, a chlorination plant for crude ore, and the Colorado, a cyanide tailing plant; and the Portland mill, which comprises a 350-ton chlorination and concentration plant for crude ore, and a 500-ton cyanide plant for tailings. The total output of these mills in bullion alone was $8,681,077 in 1910, as compared with $8,902,459 in 1909. It is said that the Portland chlorination plant is to be converted into a cyanide plant.

The United States Reduction & Refining Co. began at the close of 1910, the erection of a 500-ton plant at Florence to treat by cyanidation the tailing at the old Union mill. The tailing was formerly roasted at the Union plant, and will be pulverized to a finer mesh by tube mills.

MILLS IN THE CRIPPLE CREEK DISTRICT.

The Stratton's Independence mill started up in April, 1909, with a capacity of 4,500 tons per month, was enlarged to treat 7,000 tons in December of that year, and in November, 1910, with the addition of the second unit, reached a capacity of 9,000 tons. The process used depends on a wet concentration to remove as completely as possible the sulpho-tellurides, followed by cyanidation of the tailing, without roasting.[1] During the fiscal year ending June 30, 1910, "the mill treated 68,711 tons from the dump and shipped $150,655 in bullion and concentrates." Up to December, 1910, "the mill had treated over 120,000 tons of dump rock carrying from $3 to $4 per ton, at a cost of $1.50 per ton."[2]

The Portland Gold Mining Co. completed, near the mine at Victor, in June, its new 300-ton concentration and cyanide plant, using some modification of the cyanide process for the treatment of the tailing without roasting. The concentrates are shipped to the Portland mill at Colorado Springs for retreatment.[3]

Other mills in the district (all cyanide) were the Blue Flag, a 50-ton cyanide mill which was operated only a few months on refractory oxidized ore; the Wild Horse, operated the greater part of the year on ore from the Wild Horse group; the W. P. H. mill, operated by Gaylord on Jerry Johnson ore; the Isabella, which was operated only two months; the Trilby, a 50-ton plant, idle and torn down early in

[1] Argall, Philip Henry, Metallurgical progress in Colorado: Min. and Sci. Press., Jan. 1, 1910, p. 36.
[2] Argall, Philip Henry, Reduction of cyanide costs at Cripple Creek: Min. Science, Dec. 15, 1910, p. 567.
[3] For description and flow sheet, see Edgerton, Ward, The new Portland mill: Min. Science, July 28, 1910, pp. 76–78.

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1911; the Anaconda, on the property of the Mary McKinney, was operated at intervals; and the Copper Mountain, also idle. The Isabella mill was remodeled by a leasing company at the close of the year, and started in 1911 on ore from the old mill dump, as well as on ore from the mine dump. The Ironclad mill, a 150-ton plant, formerly operated on oxidized ores on Ironclad Hill, was idle in 1910, and the larger Homestake mill adjoining was being dismantled in 1910. The Gold Issue mill, built on the Midget-Bonanza King property, ran 8½ days in August, when it was struck by lightning and burned down. The Ajax Co. began the erection of an 100-ton plant in January, 1911, to use the Clancy process.[1]

MINES REVIEW.

The Acacia Gold Mining Co. produced—

3,972 tons, with a gross value of $70,221, in a period of 13 months to December 31, 1910, the bulk of the ore coming from the old Burns shaft and all the old workings of the claim, most of the ore from the west Basalt dike, and some from the South Burns shaft from the tenth and eleventh levels, all from lessees' work.

Ore was shipped from the Ajax group, and much development work done. Ore was also shipped from the Ajax-Uintah mines. An increased tonnage was mined from the Anchoria-Leland mine, opened by a 1,200-foot shaft. There was a small output from the Black Belle mine and from the Blanche mine. The Blue Bird mine was operated by lessees. A decreased tonnage from the Blue Flag mine was treated at the company's cyanide plant. Less ore of slightly less value per ton was shipped from the Christmas mine; the oxidized ore in this mine extends down to the 450-foot level. There was a small yield from the Commonwealth mine. There was a decreased tonnage from the School Section No. 16, mostly sulphide ore. Only a small tonnage was shipped from the Creede and Cripple Creek Co.'s mines. Mining operations on the Cresson Consolidated property were suspended for 3 months, because of the burning of the shaft house, and a smaller tonnage (mostly sulphide) was shipped. Oxidized ores extend to 600 feet. The Dante Gold Mining Co.'s annual report shows an output of "5,173 tons in 1910, with a gross value of $102,531, and total production to December 31, 1910, was 40,394 tons, with a gross value of $748,736" Considerable development work was done on company account during the last two years. The Dexter mine, idle in 1909, was operated nearly all the year 1910. The Doctor-Jack Pot Co.'s public report shows that—

the total tonnage of ore shipped during the year 1910 was 6,242 tons, and the average grade $19.75 per ton. The tonnage of ore shipped for the year 1910 was slightly larger than during the year 1909, but the decrease in value was about $25,000. There was a decrease in tonnage from the Lucky Corner claim and an increase from the Ingham, the former being of a much higher grade.

The Elkton Co. shipped about the same tonnage for 1910 as in 1909, according to the report dated February 13, 1911, from June 1, 1909, to December 31, 1910, but—

the grade of ore has been lower than the preceding year by $5.50 per ton, while freight and treatment charges have been lower on the average by $0.90 per ton. It is nearly 10 years since any sinking on the main shaft has been done. This shaft reached the 900-foot level in May, 1901, and the heavy water flows encountered on this level, together with the additional flows opened in the driving of the eighth level, con-

[1] Min. and Sci. Press, Dec. 31, 1910.

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vinced us of the folly of continuing the enormous pumping expense. * * * Then the Elkton, El Paso, Mary McKinney, and a few other companies, drove what is known as the El Paso drainage tunnel. The beneficial results of this were so plainly apparent that at last an alliance of the great majority of the important properties of the district was effected, and the so-called Roosevelt tunnel was driven, and is now furnishing drainage. During these years of waiting for drainage, our mining operations have been limited to the dry ground above the water level. This has afforded an opportunity to do a considerable amount of lateral prospecting work, which resulted in the opening of three veins lying a short distance west of the main Elkton vein. * * * Then came the drainage of the mine down to the ninth level through the El Paso tunnel, and the ore bodies of the eighth and the ninth levels were drawn upon. * * * The Roosevelt tunnel is at present running a volume of 7,300 gallons per minute, and the water in the Elkton stands at this date (Feb. 13, 1911) at 30 feet below the ninth level. It is at present receding at the rate of about 2 feet per week. * * * After this lapse of years, the sinking of the Elkton shaft has been resumed, and will be continued as fast as the water level lowers. A winze is being carried down in the main Elkton ore body, and is at present 30 feet deep. This winze shows the continuation of the ore in full width and of high grade as far as it has gone. * * *

In this period one shift of six days a week was employed. No lessees worked through the main workings, but four sets worked elsewhere on the property. The output for 19 months was 32,693 dry tons, averaging $22.05 per ton, of which 5,024 tons averaged $13.46 per ton, 2,146 tons of dump ore averaged $7.44, and 25,532 tons averaged $24.95 per ton. The average freight and treatment charges were $5.70 per ton.

The El Paso Consolidated Gold Mining Co.'s report, dated March 6, 1911, shows that—

in the year 1910, the gross ore sales from lessees was $505,233. The company has recovered, on the main shaft, two levels, and in 10 days hopes to recover the 1,000-foot level and to commence mining ore. During the year the Roosevelt tunnel developed 1,880 feet of the El Paso property on the tunnel level. The El Paso drove 80 feet of a crosscut and upraised 25 feet on the tunnel level to connect with a drill hole from the bottom of the shaft, the drill hole being 332 feet, making almost 1,300 feet from the collar of the shaft to the tunnel level. The Tunnel Co. also drove a 540-foot crosscut to cut the C. K. & N. vein, 500 feet east of the main shaft. There was a total of 8,262 feet of development work by lessees and the company. There were 25 sets of lessees, only ground above the fourth level being leased. Below this point will be worked on company account.

There was an increased tonnage from the Ethel Louise mine. The average value of the ore "shipped from the Findley mine was $19.75, and the average treatment $6.55 per ton," and a decreased tonnage was shipped. The output from the Forest Queen mine showed an increase; from the Free Coinage, a decrease; and from the Gold Bond, a decrease. Lessees shipped a large tonnage from the property of the Gold Dollar Co., chiefly from the Mabel M. mine, and lessees also shipped an increased tonnage from the El Paso-Gold King mines, in Poverty Gulch. An increased output was made by lessees on the Gold Sovereign mine. The Golden Cycle mines made an increased output. High grade ore has been opened at a depth of 1,540 feet. The Granite group yielded a decreased tonnage from the operations of lessees. An increased tonnage was mined from the Henry Adney mine in five months' operations. A decreased tonnage was mined from the Hiawatha mine and from the Index property.

The Isabella Mines Co. report shows the "lessees' gross ore sales, $213,745; company gross ore sales, $6,548; mill bullion, $11,009; total, $231,302." The mill was closed after a few months' run and a leasing company has remodeled the plant.

The ore production from the Jennie Sample mine was less than in 1909. Little development work was done on the Jerry Johnson mine, a lessee treating about half the ore extracted in the W. P. H.

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(or Gaylord) mill and shipping the rest to mills. "The ore shipped during the fiscal year ending August 31, 1910, was 12,469 tons of a gross value of $279,362." Lessees mined a considerable tonnage from the Jo Dandy mine, a moderate tonnage was mined from the Jolly Tar mine, and an increased output was made from the Katinka (or Chicken Hawk) mines, from the Last Dollar mines, and from the Lexington mines. A lessee shipped a considerable tonnage of higher than average ore from the Maggie mine. Increased output was made from the Magnet Rock properties, a decreased yield from the Mary Cashen mine, and an increased yield from the Mary Jane property.

Lessees on the Mary McKinney property, as shown in a report dated January 31, 1911—

in 18 months from July 1, 1909, to December 31, 1910, produced 22,136 tons of ore of a gross value of $433,096. The water is falling at the rate of 12 to 15 feet per month as a result of the drainage tunnel. The company is preparing to sink the shaft 100 feet as the water recedes.

Production was made from the Michigan Co.'s Clara D. mine on Gold Hill, and from the Midget-Bonanza King mines. The mill of the latter company burned down after running several days. The Modoc Co. maintained an even yield from the Ocean View mine. There was a decreased yield from the Mohican mine, but a considerable tonnage from the Mollie Kathleen mine, and an increased output from the Moon Anchor mine. The Ophir mine was a producer, but there was a decreased output from the Dead Pine mine of the Ophir Mining Co. The Peggy mine, idle in 1909, was a producer and there was an increased yield from the Pharmacist mine and from the Pinnacle mine.

As shown by the annual report of the Portland Gold Mining Co.—

the gross tonnage mined and shipped to the Colorado Springs mill was 67,515 tons and the gross value $1,241,168, at an average of $18.32 per ton, as compared with 83,908 tons, having a gross value of $1,438,650, at an average value of $17.14 per ton in 1909, and with 94,311 tons, having a gross value of $1,834,081, and an average per ton of $19.45, in 1908. Besides the new mill recovered $113,253, mostly from low-grade ore taken out in development work (the tonnage treated not being published), making the drifts a source of profit, instead of a total loss as heretofore. A new mill at the mine was completed in June, making available for profitable treatment 3,000,000 tons of ore now on the dump, in addition to large bodies of low-grade ore in the mine. The effect of the new drainage tunnel was already (report dated Feb. 6, 1911) becoming evident, as the water in the fifteenth level has receded 17 feet. This level was abandoned and allowed to fill up 18 months ago on account of the great expense of pumping. The development of new ore has more than kept pace with extraction. Heavy expense was incurred during the year preparatory to the removal of the backs of old stopes, from which a large tonnage is expected. To December 31, 1910, from April 1, 1894, the total tonnage sold or treated was 1,100,805 tons (not including tonnage to new mill at Victor in 1910) with a total gross value of $31,262,515 (including $113,253 recovered by new mill in 1910), and the total dividends were $8,677,080. The total development is 43 miles.

A considerable tonnage was mined from the Pride of Cripple Creek mine by lessees. The Prince Albert mine produced "but 941 tons, of an average value of $9.26, with a gross value of $8,712.41." There was an increased output from the Ruby mine of the Princess Alice Co., and also from the Ramona mine, but a decreased yield from the Requa-Savage mine.

The report for the Stratton's Independence mine for the fiscal year ending June 30, 1910, shows "that lessees shipped from the mine 24,400 tons valued at $577,242. The mill treated 68,711 tons from the dump and shipped $150,655 in bullion and concentrates."

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The Stratton-Cripple mines on Bull Hill, Globe Hill, and in Poverty Gulch, operated by lessees, produced less than in 1909. Operations on the Strong mine resulted in about the same output as in 1909, as is true of the Trilby mine. The United Gold mines, operated under the leasing system, were important producers. This company's annual report shows that—

royalties on lessees' ore shipments, for the year ending December 31, 1910, were $28,741. The company has spent no money on development in 1910 since May. Lessees spent $93,150 on development work during the last three months, and the company spent $3,550. Mining developments by the company during the last year amounted to 365 feet, the total of lessees was 2,272 feet. There are now 25 lessees and shipments are being made from the W. P. H., the Damon group, the Deadwood group, the May B group, the Silver Tip group, the Wild Horse group, and the Trail group.

Lessees shipped a considerable tonnage from the Victor mine.

The Vindicator Consolidated Gold Mining Co. in its annual report shows—

the production for 1910 to have totaled 33,150 tons of the assay value of $944,105, as compared with 31,664 tons, valued at $895,848 in 1909. The main shaft will be soon sunk an additional 200 feet from its present depth of 1,400 feet. At the 1,300-foot and 1,400-foot levels new ore bodies have been developed, and at the bottom level, 1,400 feet, a continuous ore body, about 990 feet long and still in good ore, has been developed. The Golden Cycle, adjoining, has opened high-grade ore at a depth of 140 feet below the bottom level of the Vindicator, and there is every indication that the same condition will obtain in the Vindicator.

There was a moderate yield from the mines of the Work Co.

The following table shows the production of the Cripple Creek district from 1891 to 1910, inclusive:

Production of the Cripple Creek district, Colorado, 1891–1910.[a]

Year.	Gold value.	Silver.		Total value.
		Quantity.	Value.	
		Fine ounces.		
1891	$449			$449
1892	583,010			583,010
1893	2,010,367	5,019	$3,915	2,014,282
1894	2,908,702	25,900	16,317	2,925,019
1895	6,879,137	70,448	45,791	6,924,928
1896	7,512,911	60,864	41,387	7,554,298
1897	10,139,709	57,297	34,378	10,174,087
1898	13,507,244	68,195	40,235	13,547,479
1899	15,658,254	82,520	49,512	15,707,766
1900	18,073,539	80,166	49,703	18,123,242
1901	17,261,579	90,884	54,530	17,316,109
1902	16,912,783	62,690	33,226	16,946,009
1903	12,967,338	42,210	22,793	12,990,131
1904	14,456,536	47,817	27,734	14,494,270
1905	15,641,754	56,951	34,740	15,676,494
1906	13,930,526	67,943	46,201	13,976,727
1907	10,370,284	51,630	34,076	10,404,360
1908	13,031,917	52,270	27,703	13,059,620
1909	11,466,227	63,204	32,866	11,499,093
1910	11,002,253	54,263	29,302	11,031,555
Total	214,314,519	1,040,271	624,409	214,938,928

[a] Figures for 1891–1903 from reports of the Director of the Mint; figures 1904–1910 actual recovery by mills and smelting. In 1907 the Portland Co. installed a cyanide plant to treat the accumulated tailings of previous years and to treat tailings from the chlorination barrels. The Colorado plant of the United States Reduction & Refining Co. is also the cyanide auxiliary plant to the Standard chlorination plant, and old tailings of previous years as well as tailings from day to day from the Standard plant are treated here.

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IDAHO.

By C. N. Gerry.

PRODUCTION.

From a production valued at $15,660,849, derived from 324 mining properties in 1909, Idaho increased its output to a value of $16,316,196 from 417 productive properties in 1910. This increase in the number of producers is not significant, since 262 of the properties were placers, many of which made meager outputs. The gold production was unusually low in 1910, being only 53,059.73 ounces, valued at $1,096,842, a decrease of $356,980. The production of silver was 7,369,742 ounces, valued at $3,979,661, an increase of 328,109 ounces and of $318,012 in value. There was a decrease in copper, but a material increase in both lead and zinc. There were 1,786,174 tons of ore shipped or treated, having an average value per ton of $8.99. Of this total, 111,156 tons, or 6 per cent, treated in gold and silver mills, resulted in bullion, with a gold value of $674,442 and a silver value of $170,292, or a value per ton in both metals of $7.60. Over 7 per cent of the total tonnage, or 131,655 tons, was shipped crude to smelters. This ore had a total value per ton of $33.98. Nearly 86 per cent of the tonnage, or 1,533,862 tons, largely Cœur d'Alene silver-lead ore, was treated in concentration plants and reduced to 199,327 tons of concentrates, which had a value of $53.95 per ton. There was a decrease in output of both copper ore and siliceous ore, but there were increases in production of lead ore and zinc ore. The total tonnage is divided into 115,444 tons of siliceous ore, or 6.5 per cent; 70,163 tons of copper ore, or 3.9 per cent; 1,566,561 tons of lead ore, or 87.7 per cent; and 34,006 tons of zinc ore, or 1.9 per cent, of the total. There were 63 milling plants in operation during the year, but some of them were operated for only short periods. Of these, 2 were cyanide mills, 19 were purely concentration plants, and 42 were gold and silver mills using amalgamation alone or amalgamation and concentration. There were produced 918 tons of concentrates from gold and silver mills which contained gold valued at $58,753, 42,279 ounces of silver, 4,362 pounds of copper, and 1,465 pounds of lead. There was a decrease in output of both bullion and concentrate from these gold and silver mills, since only about 8 of the 42 were active for more than six months.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	70,328.64	$1,453,822	53,059.73	$1,096,842	− 17,268.91	−$356,980
Silver.....do....	7,041,633	3,661,649	7,369,742	3,979,661	+ 328,109	+ 318,012
Copper.....pounds..	9,115,489	1,185,014	7,037,292	893,736	− 2,078,197	− 291,278
Lead.....do....	215,986,285	9,287,410	228,258,839	10,043,389	+12,272,554	+ 755,979
Zinc.....do....	1,351,010	72,954	5,603,114	302,568	+ 4,252,104	+ 229,614
Total.....	.....	15,660,849	.....	16,316,196	.....	+ 655,347

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The production for Idaho for the last seven years, as given in the table below, shows an increase in production of ore, metals, and values in 1904, 1905, and 1906, a decline in 1907 and 1908, and a slight increase in 1909 and 1910.

Total tons of ore sold or treated in Idaho in 1904–1910, and total content of gold, silver, copper, lead, and zinc.

Year.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1904	1,668,327	82,739.00	7,666,382	5,087,518	233,096,375	2,600	$16,933,405
1905	1,669,038	52,033.00	8,679,093	7,321,585	259,812,428	1,228,449	19,743,620
1906	1,787,673	55,587.73	9,018,815	9,558,913	255,014,446	2,065,597	23,698,400
1907	1,690,860	60,754.70	8,415,431	10,890,731	233,823,854	6,985,732	21,793,064
1908	1,089,231	69,827.33	7,469,981	10,041,850	206,827,816	37,410	15,416,599
1909	1,772,383	70,328.64	7,041,633	9,115,489	215,986,285	1,351,010	15,660,849
1910	1,786,174	53,059.73	7,369,742	7,037,292	228,258,839	5,603,114	16,316,196

GOLD.

There was a marked decrease in the gold production of the State, from 70,328.64 ounces, valued at $1,453,822 in 1909, to 53,059.73 ounces, valued at $1,096,842, in 1910, a decrease of 17,268.91 ounces in quantity and of $356,980 in value. This reduction was in part traceable to the closing of the Buster mine in Idaho County and the Trade Dollar mine in Owyhee County, and to decreased outputs from the Sunbeam mine in Custer County and from several mines in Lemhi County. No county had an increase of importance. Owyhee County retained first place in output of gold with Boise and Elmore following, while Idaho County, third in 1909, fell to fifth place in 1910. There were 262 placers, from which $242,546 in gold was derived, a decrease of $39,181 in output of placer gold. Hydraulic and sluicing mines produced $150,328 on 251 properties, $971 was recovered by drift mining on 5 properties, and $91,247 by 6 dredges. Siliceous ore supplied most of the gold, or 71 per cent; placers, 22 per cent; lead ore, 6 per cent; and copper ore, 1.4 per cent. Snake River in various counties supplied fine gold valued at $6,681. Crude shipping ore yielded gold valued at $57,132, or at an average of 43 cents per ton. Concentrates contained gold valued at $122,722, of which $59,753 represented concentrates from gold and silver mills at an average value of $65.09 per ton, and $62,969 represented the gold in lead concentrates averaging 32 cents per ton. Gold production from mill bullion was valued at $674,442, or $6.07 per ton, from the treatment of 111,156 tons of ore in gold and silver mills.

Source of gold production in Idaho, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Ada	15.53	53.64				69.17
Bingham	64.97					64.97
Blaine		1,654.01		367.01	26.93	2,047.95
Boise	6,272.45	3,374.97				9,647.42
Bonner		40.83				40.83
Canyon	4.11					4.11
Cassia				62.84		62.84
Custer	255.71	593.45	265.25	.97		1,115.38
Elmore	144.40	8,576.74				8,721.14

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Source of gold production in Idaho, by kinds of ore, in 1910, by counties, in fine ounces—Continued.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Fremont	3.00			.34		3.34
Idaho	888.55	2,201.89				3,090.44
Kootenai and Latah	657.07		.54			657.61
Lemhi	772.98	2,189.19		277.07		3,239.24
Lincoln	17.03					17.03
Nez Perce	1,968.81	6.39				1,975.20
Oneida	100.72					100.72
Owyhee	30.77	18,773.95				18,804.72
Shoshone	436.20		492.13	2,219.72		3,148.05
Twin Falls	75.42					75.42
Washington	25.44	140.83	7.88			174.15
Total	11,733.16	37,605.99	765.80	2,927.95	26.93	53,059.73

SILVER.

The production of silver was 7,369,742 ounces, valued at $3,979,661, an increase of 328,109 ounces in quantity and of $318,012 in value. With the resumption of shipments of lead ore from Gilmore, there was a marked increase in output from Lemhi County, and the Stewart and Caledonia mines aided in bringing Shoshone County an increase in silver, but a large decrease was recorded in Owyhee County.

Shoshone County alone yielded nearly 91 per cent of the total silver. Siliceous ore yielded 5.3 per cent of the total silver output, or 393,795 ounces; copper ore, 6.4 per cent, or 475,363 ounces; and lead ore, 88 per cent, or 6,479,636 ounces. Zinc ore and placers contributed less than 1 per cent. Silver production increased from lead ore, but decreased from copper ore and siliceous ore. The crude shipping ore contained 2,588,431 ounces of silver, or nearly 20 ounces per ton. Concentrates contained 60.5 per cent of the silver (4,463,517 ounces), or 22.3 ounces per ton. Included in this total was silver from concentrates made at gold and silver mills (47,279 ounces), or 51.5 ounces per ton. Ore treated at gold and silver mills produced in bullion 315,356 ounces of silver, valued at $170,292, or $1.53 per ton.

Source of silver production in Idaho, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Ada	5	257				262
Bannock			11			11
Bingham	1					1
Blaine		4,904		87,198	494	92,596
Boise	1,433	13,010				14,443
Bonner		14,428		144		14,572
Cassia				351		351
Custer	101	948	28,754	1,466		31,269
Elmore	56	16,798				16,854
Fremont				2,195		2,195
Idaho	156	1,588				1,744
Kootenai and Latah	64		17			81
Lemhi	66	355		149,764		150,185
Lincoln	1					1
Nez Perce	449	17				466
Oneida	10					10
Owyhee	12	341,482				341,494
Shoshone	75		446,471	6,238,518	18,016	6,703,080
Twin Falls	3					3
Washington	6	8	110			124
Total	2,438	393,795	475,363	6,479,636	18,510	7,369,742

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COPPER.

The production of copper in Idaho decreased from 9,115,489 pounds, valued at $1,185,014, in 1909, to 7,037,292 pounds, valued at $893,736, in 1910, a decrease of 2,078,197 pounds in quantity and $291,278 in value. In Custer County, which is the only county beside Shoshone that produces any large quantity of copper, the Lost Packer and Empire plants were idle, but a large tonnage of copper ore was shipped from the White Knob mine. Aside from the bulk of the copper, or 84 per cent, derived from copper ore, 15 per cent came from lead ore and less than 1 per cent from siliceous ore.

Source of copper production in Idaho, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Siliceous ore.	Copper ore.	Lead ore.	Total.
Ada	4			4
Bannock		1,114		1,114
Blaine	13,725		6,293	20,018
Boise	5,957			5,957
Bonner	5,646			5,646
Cassia			133	133
Custer		919,492	156	919,648
Elmore	15			15
Fremont			73	73
Kootenai and Latah		6,166		6,166
Lemhi			54,887	54,887
Shoshone		4,980,677	1,038,011	6,018,688
Washington		4,943		4,943
Total	25,347	5,912,392	1,099,553	7,037,292

LEAD.

Lead production in Idaho increased from 215,986,285 pounds, valued at $9,287,410, in 1909, to 228,258,839 pounds, valued at $10,043,389, in 1910. This increase of 12,272,554 pounds in quantity and of $755,979 in value was almost equally divided between Shoshone and Lemhi counties. The output of Blaine County lead was greatly decreased. The resumption of shipments from Gilmore with the advent of the railroad increased Lemhi County production materially.

Source of lead production in Idaho, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Siliceous ore.	Lead ore.	Zinc ore.	Total.
Ada	100			100
Blaine	1,968	1,282,998		1,284,966
Boise	3,001			3,001
Bonner	5,737	1,481		7,218
Cassia		25,485		25,485
Custer		19,086		19,086
Fremont		633,102		633,102
Lemhi	526	6,525,948		6,526,474
Owyhee	1,365			1,365
Shoshone		219,157,456	600,586	219,758,042
Total	12,697	227,645,556	600,586	228,258,839

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ZINC.

There was a substantial increase in the zinc output of Idaho, from 1,351,010 pounds, valued at $72,954, in 1909, to 5,603,114 pounds, valued at $302,568, in 1910. With the exception of a few mines in Blaine County, the zinc product was derived entirely from the Success mine, in Shoshone County, which was active the entire year. All of the zinc output came from zinc ore.

MINING INDUSTRY IN IDAHO IN 1910.

In 1910 the mining industry of Idaho was characterized by the improvement in the silver-lead ore output, but by a decided decrease from placers, siliceous ore, and copper ore. Though the State has several smelting plants, almost all the ore was shipped to outside establishments for treatment. Plants at Ponderay, in Bonner County, and at Mackay and Ivers, in Custer County, were idle. The only smelting done in 1910 was a short run at Hahn, in Lemhi County, and trial runs of a small lead plant at Enaville. The event which affected Lemhi County generally, and resulted in the increased production of lead ore, was the completion and operation of the Gilmore & Pittsburg Railroad from Armstead, Mont., to Salmon, Idaho, in July. In Shoshone County, the Chicago, Milwaukee & Puget Sound Railway was fully operated in 1910, thus giving the southern part of the county a better opportunity for development. At the Golden Age mine, in Boise County, 5 stamps were added, and at the Gold Hill mine a 100-ton mill was completed. In Bonner County a concentrator was constructed at the Idaho Continental mine. A new 10-stamp mill was erected at the Homestake property, in Elmore County, and 5 stamps were added at the Franklin mine. In Idaho County stamp mills were added at the Grangeville, Comstock, and Olivia properties. Construction on a large stamp mill was in progress at the Italian mine, in Lemhi County, and concentrators were constructed at the Black Horse and Monarch mines, in Shoshone County. At several mines in the Cœur d'Alene district sorting plants were added to prevent running the rich ore through the mills. There was no improvement in the production of gold from dredges, though the new dredge at Pierce was operated. A new dredge was also shipped to Idaho City, in Boise County, which will have a capacity of about 8,000 cubic yards per day. This will not only be the largest dredge in the State, but will treat, if operated successfully, more gravel than the other dredges combined. Lead shipments were somewhat hampered by snowslides in the early part of the year and by forest fires in August. In March one of the old producers of Owyhee County was closed.

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Mine production of gold, silver, copper, lead, and zinc in Idaho in 1910, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Ada	69.17	$1,430	262	$142	4	$1
Bannock			11	6	1,114	141
Bingham	64.97	1,343	1	1		
Blaine	2,047.95	42,335	92,596	50,002	20,018	2,542
Boise	9,647.42	199,430	14,443	7,798	5,957	757
Bonner	40.83	844	14,572	7,869	5,646	717
Canyon	4.11	85				
Cassia	62.84	1,299	351	189	133	17
Custer	1,115.38	23,057	31,269	16,886	919,648	116,795
Elmore	8,721.14	180,282	16,854	9,101	15	2
Fremont	3.34	69	2,195	1,185	73	9
Idaho	3,090.44	63,885	1,744	942		
Kootenai and Latah	657.61	13,594	81	43	6,166	783
Lemhi	3,239.24	66,961	150,185	81,100	54,887	6,971
Lincoln	17.03	352	1	1		
Nez Perce	1,975.20	40,831	466	251		
Oneida	100.72	2,082	10	5		
Owyhee	18,804.72	388,728	341,494	184,406		
Shoshone	3,148.05	65,076	6,703,080	3,619,664	6,018,688	764,373
Twin Falls	75.42	1,559	3	2		
Washington	174.15	3,600	124	67	4,943	628
Total	53,059.73	1,096,842	7,369,742	3,979,661	7,037,292	893,736

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Ada	100	$4			$1,577
Bannock					147
Bingham					1,344
Blaine	1,284,966	56,539	76,397	$4,125	155,543
Boise	3,001	132			208,117
Bonner	7,218	318			9,748
Canyon					85
Cassia	25,485	1,121			2,626
Custer	19,086	839			157,577
Elmore					189,385
Fremont	633,102	27,857			29,120
Idaho					64,827
Kootenai and Latah					14,420
Lemhi	6,526,474	287,165			442,197
Lincoln					353
Nez Perce					41,082
Oneida					2,087
Owyhee	1,365	60			573,195
Shoshone	219,758,042	9,669,354	5,526,717	298,443	14,416,910
Twin Falls					1,561
Washington					4,295
Total	228,258,839	10,043,389	5,603,114	302,568	16,316,196

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Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Idaho in 1909 and 1910, by counties.

County.	Total tonnage of ore sold or treated.		Deep mines producing.		Total average value per ton.		Average value per ton in gold and silver.		Total value of deep-mine output.
	1910.	Increase (+) or decrease (−).	1909.	1910.	1909.	1910.	1909.	1910.	
	Short tons.	*Short tons.*							
Ada	131	+ 32	3	4	$9.75	$9.56	$9.75	$9.53	$1,253
Bannock	52	+ 12	1	1	4.70	2.83	.18	.11	147
Bingham		− 40	1		10.70		10.70		
Blaine	17,042	− 3,331	15	23	8.97	9.13	4.92	5.42	155,543
Boise	11,444	+ 2,739	17	12	8.86	6.79	8.75	6.71	77,681
Bonner	227	+ 28	4	6	74.10	42.94	70.87	38.38	9,748
Cassia	44	+ 44		1		59.68		33.82	2,626
Custer	9,973	− 5,195	13	8	7.01	15.26	6.01	3.47	152,236
Elmore	34,301	−22,546	8	12	3.48	5.43	3.48	5.43	186,370
Fremont	557	+ 186	2	1	52.15	52.17	2.22	2.14	29,068
Idaho	6,351	−19,414	17	20	7.00	7.30	7.00	7.30	46,375
Kootenai and Latah	66	+ 66		2		12.16		.30	803
Lemhi	15,392	− 4,435	11	22	6.07	27.69	5.48	8.58	426,182
Nez Perce	12	− 157	2	1	2.39	11.75	2.39	11.75	141
Owyhee	50,297	− 5,036	12	11	13.74	11.38	13.74	11.38	572,553
Shoshone	1,639,781	+70,449	27	25	8.74	8.78	2.10	2.24	14,407,852
Twin Falls, Washington	504	+ 389	2	6	52.47	7.47	4.55	6.22	3,766
Total	1,786,174	+13,791	135	155	8.68	8.99	2.73	2.70	16,072,334

Tonnage of milling and smelting ore and concentrates, with metallic contents, produced in Idaho in 1910, by counties.

County.	Ore to gold and silver mills.			Quantity of ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Ada	131	33.40	27	
Bannock				52
Blaine	3,586	328.82	216	3,536
Boise	7,794	1,876.99	8,878	3,510
Bonner	10	15.00	3	
Custer	2,738	539.43	708	20
Elmore	34,293	7,483.41	9,866	
Idaho	6,251	1,834.21	535	
Lemhi	5,569	2,106.27	251	
Nez Perce	12	6.39	17	
Owyhee	50,288	18,261.44	294,847	
Shoshone				1,526,744
Washington	484	140.85	8	
Total	111,156	32,626.21	315,356	1,533,862

County.	Concentrates produced.						Total value of concentrates.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Ada	21	20.24	230	4	100		$547
Bannock	13		11	1,114			147
Blaine	2,556	917.47	58,705	8,231	693,220		82,214
Boise	921	1,391.02	3,957	5,957	3,001		31,781
Bonner							
Custer	17	54.03	833	156	6,966		1,891
Elmore	290	1,039.89	6,794				25,165
Idaho	68	367.68	1,053				8,170
Lemhi	12	48.71	30				1,023
Owyhee	91	489.03	35,898		1,365		29,554
Shoshone	195,338	1,608.60	4,356,006	633,458	177,469,820	5,526,717	10,573,060
Total	199,327	5,936.67	4,463,517	648,920	178,174,472	5,526,717	10,753,552

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Tonnage of milling and smelting ore and concentrates, with metallic contents, produced in Idaho in 1910, by counties—Continued.

County.	Crude ore to smelters.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ozs.*	*Fine ozs.*	*Pounds.*	*Pounds.*	*Pounds.*	
Blaine	1,192	801.66	33,675	11,787	591,746	76,397	$66,416
Boise	70	106.96	175	.....	.....	.....	2,306
Bonner	217	25.84	14,569	5,646	7,218	.....	9,436
Cassia	44	62.86	351	133	25,485	.....	2,626
Custer	7,215	266.21	29,627	919,492	12,120	.....	138,810
Elmore	8	53.44	138	15	.....	.....	1,182
Fremont	557	.34	2,195	73	633,102	.....	29,058
Latah	66	.54	17	6,166	.....	.....	803
Lemhi	9,823	311.28	149,838	54,887	6,526,474	.....	381,482
Owyhee	9	23.48	10,737	.....	.....	.....	6,283
Shoshone	112,434	1,103.25	2,346,999	5,385,230	42,288,222	.....	3,834,792
Washington	20	7.86	110	4,943	.....	.....	850
Total	131,655	2,763.69	2,588,431	6,388,372	50,084,367	76,397	4,474,044

Subdivision of tonnage of ore sold or treated in Idaho in 1910, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Ada	131	.....	.....	.....	131
Bannock	.....	52	.....	.....	52
Blaine	3,893	.....	13,027	122	17,042
Boise	11,444	.....	.....	.....	11,444
Bonner	185	.....	42	.....	227
Cassia	.....	.....	44	.....	44
Custer	2,738	7,206	29	.....	9,973
Elmore	34,301	.....	.....	.....	34,301
Fremont	.....	.....	557	.....	557
Idaho	6,351	.....	.....	.....	6,351
Kootenai and Latah	.....	66	.....	.....	66
Lemhi	5,608	.....	9,784	.....	15,392
Nez Perce	12	.....	.....	.....	12
Owyhee	50,297	.....	.....	.....	50,297
Shoshone	.....	62,819	1,543,078	33,884	1,639,781
Washington	484	20	.....	.....	504
Total	115,444	70,163	1,566,561	34,006	1,786,174
Value per ton in gold and silver	$8.57	$3.88	$2.27	$0.31	$2.70

Mine production of placer gold in Idaho in 1909 and 1910, by counties.

County.	1909	1910
Ada	$2,521	$321
Bingham	3,135	1,343
Blaine	118	.....
Boise	143,492	129,663
Canyon	316	85
Cassia	553	.....
Custer	6,622	5,286
Elmore	3,320	2,985
Fremont	136	62
Idaho	28,540	18,368
Kootenai and Latah	2,883	13,583
Lemhi	24,068	15,979
Lincoln	889	352
Nez Perce	45,125	40,699
Oneida	1,836	2,062
Owyhee	1,693	636
Shoshone	13,787	9,017
Twin Falls	2,693	1,559
Washington	.....	526
Total	281,737	242,546

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Gold production of Idaho placers by different methods in 1909 and 1910.

	Hydraulic.[a]	Drift.	Dredge.	Total.
1909.....fine ounces..	8,570.31	138.31	4,919.92	13,628.54
1910.....do....	7,272.10	46.99	4,414.07	11,733.16

[a] Includes sluicing.

There were 417 producing properties in 1910, of which 155 were deep mines and 262 were placers. Of the placers, 251 were hydraulic or sluicing mines, 5 were drift mines, and 6 were dredges. The deep mines were classified as follows: Gold, 3; gold and silver, 77; gold, silver, and copper, 11; gold, silver, copper, and lead, 30; gold, silver, and lead, 17; silver and lead, 9; silver and copper, 2; gold, silver, copper, lead, and zinc, 1; and silver, copper, and lead, 5.

REVIEW BY COUNTIES.

ADA COUNTY.

The total production of Ada County was valued at $1,577 in 1910, a decrease of $1,925. The output was from 11 mines which were mostly small placers.

Black Hornet district.—Bullion in small lots was sold from the Red Rose, the Grey Eagle, and the Ironsides quartz claims.

Boise and Payette River districts.—Small amounts of placer gold were secured by sluicing along Boise and Payette rivers.

McIntyre district.—The Celtic mine and mill were operated for a short time and produced bullion and concentrate.

BANNOCK COUNTY.

Fort Hall district.—Aside from small shipments of concentrates from the Fort Hall mine and some development on the Papoose, nothing was done in this region in 1910.

BEAR LAKE COUNTY.

In Bear Lake County only development work was reported, particularly at the Bonanza mine.

BINGHAM COUNTY.

Bingham County produced from placers, gold and silver valued at $1,344, a decrease of $2,223.

Mount Pisgah district.—Only $268 in placer gold was marketed, the largest operator in the past being idle in 1910.

Snake River district.—At Aberdeen, Blackfoot, and Otis, $1,075 in gold was sluiced from Snake River by 8 operators.

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BLAINE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Blaine County, Idaho, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	1,948.74	$40,284	2,047.95	$42,335	+ 99.21	+$2,051
Silver.....do....	115,301	59,957	92,596	50,002	− 22,705	− 9,955
Copper.....pounds..	22,740	2,956	20,018	2,542	− 2,722	− 414
Lead.....do....	1,762,268	75,777	1,284,966	56,539	−477,302	−19,238
Zinc.....do....	71,010	3,834	76,397	4,125	+ 5,387	+ 291
PLACERS.						
Gold.....fine ounces..	5.71	118	.....	.....	− 5.71	− 118
Silver.....do....	2	1	.....	.....	− 2	− 1
Total.....	.....	182,927	.....	155,543	.....	−27,384

Source of gold and silver in Blaine County, Idaho, in 1909 and 1910, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Lead-zinc ore.	Total.
Gold.....	1909	5.71	1,564.10	.....	363.19	.....	21.45	1,954.45
	1910	.....	1,654.01	.....	367.01	26.93	.....	2,047.95
Silver.....	1909	2	6,980	.....	81,411	.....	26,910	115,303
	1910	.....	4,904	.....	87,198	494	.....	92,596

The total value of Blaine County output in 1910 was decreased by $27,384. There was decreased output in silver, copper, and lead; slight increases were made in gold and zinc. From 23 deep mines, an increase of eight, 17,042 tons of ore or tailings were treated. Of this total tonnage 3,586 tons were treated at gold and silver mills, from which $1.93 per ton was recovered by amalgamation; 1,192 tons were crude smelting ore, valued at $66,416; 3,536 tons of ore were concentrated, which, with 8,728 tons of old tailings re-treated, made 2,556 tons of concentrate, valued at $82,214, or at $32.17 per ton. Crude ore shipped averaged in value $55.72 per ton.

Dome district.—The Wilbert property supplied a few shipments of lead ore, but was idle most of the year.

Hamilton district.—From the Badger Creek group a good grade of silver-lead ore was smelted.

Little Smoky district.—The Cannon Ball mine was idle on account of litigation, but a few tons of old concentrate were shipped.

Little Wood River district.—The concentration plant of the Muldoon Mining Co. was active part of the year and several hundred tons of lead concentrate were shipped, but in December the company was in the hands of a receiver.

Mineral Hill district.—The output of the district amounted to $38,599 in gold, 79,720 ounces of silver, 19,585 pounds of copper, 997,466 pounds of lead, and 47,012 pounds of zinc, in all valued at $130,562, or at $8.66 per ton of crude ore. Twelve mines supplied

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the output, a decrease from that of 1909. The largest producers were the Croesus and Idaho Consolidated mines. The former supplied the bullion of the district, as well as crude lead ore, lead concentrate, and gold concentrate. The 150-ton concentration plant of the Idaho Consolidated was in use from May 15 to September on old tailings, resulting in considerable lead-silver concentrate. The Eureka, a large producer in past years, was practically idle. Rich lead ore was shipped from the Comet, and tests were made on gold ore from the Hope, near the Croesus. At the Nay Aug mine, which was operated the entire year, the work on building an electric power plant was begun. Shipments consisted of both a lead ore and a zinc ore. Other shipments were made from the Silver Mountain, Jay Gould, and Fourth of July mines.

Skeleton Creek district.—The erection of a 10-stamp amalgamation mill at the El Oro property was completed in October. Trial runs were made, but water was lacking for constant operation.

Soldier district.—The Bear Creek M. & M. Co., operating 68 miles west of Hailey, treated some ore in a 3-ton mill.

Warm Springs district.—Production from this district was $201 in gold, 3,531 ounces of silver, 107 pounds of copper, 35,375 pounds of lead, and 29,385 pounds of zinc, with a total value of $5,264. The producing mines were the Big Bononza, the New Hope, the North Star, and the Million.

BOISE COUNTY.

Mine production of gold, silver, copper, and lead, in Boise County, Idaho, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	3,509.07	$72,539	3,374.97	$69,767	− 134.10	−$ 2,772
Silver.....do....	6,919	3,598	13,010	7,025	+ 6,091	+ 3,427
Copper.....pounds..	2,185	284	5,957	757	+ 3,772	+ 473
Lead.....do....	15,410	663	3,001	132	− 12,409	− 531
PLACERS.						
Gold.....fine ounces..	6,941.43	143,492	6,272.45	129,663	− 668.98	− 13,829
Silver.....do....	1,565	814	1,433	773	− 132	− 41
Total.....	.....	221,390	.....	208,117	.....	− 13,273

Source of gold and silver in Boise County, Idaho, in 1909 and 1910, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Total.
Gold	1909	6,941 43	3,509.07	10,450.50
	1910	6,272.45	3,374.97	9,647.42
Silver	1909	1,565	6,919	8,484
	1910	1,433	13,010	14,443

Gold production from both deep and placer mines decreased slightly in 1910. There were 12 producing deep mines and 56 placers, including 2 dredges. The tonnage of ore produced increased from

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8,705 tons in 1909 to 11,444 tons in 1910, and had a total average value in 1910 of $6.79 per ton. The ore represented 70 tons shipped crude, 3,510 tons that were concentrated, and 7,794 tons treated at 3 gold and silver mills. There were 921 tons of concentrates produced, valued at $31,781, or $34.51 per ton, a small part of which was derived from gold and silver mills.

Banner district.—At the Edna mine, north of Idaho City, a silver chloride ore was treated by cyanidation. The mine was closed after a 60 days' run.

Boise Basin region.—From 42 placers and 7 deep mines this region produced $168,051 in gold, 2,615 ounces of silver, 222 pounds of copper, and 3,001 pounds of lead. Of this production, the placer output was $127,954 in gold and 1,409 ounces of silver. All the ore, or 7,386 tons, was treated at gold and silver mills. The largest placer operators were the Moline, Boston & Idaho, White Quartz, Harwood Glen, Boise Basin Hydraulic & Power, Centerville, and Leary mines. The White Quartz Co. acquired the Basin Branch or Woodburn placer, and other ground in the vicinity. Dredges were operated by the Moline Co. and the Boston & Idaho Gold Dredging Co. In September the latter company was receiving machinery for a new dredge of the stacker type, which will be the second largest plant in the intermountain region, the buckets having a capacity of 13½ cubic feet each. The deep mines of the region produced 7,386 tons of ore, containing $40,097 in gold, 1,206 ounces of silver, and small qualities of copper and lead. The Golden Age mine was the largest producer, having a 10-stamp mill in operation from May until November. From the Gold Hill and Iowa property, bullion was produced by a short run of the mill. The Pioneer shaft was sunk to the 500-foot level, and the plant, consisting of 20 stamps, Chilian mill, with concentration and cyanide equipment, was completed. The Columbia and Molly McCarthy mines were also productive of bullion to a small degree.

Deadwood Basin district.—There was a small placer and bullion production from the Merry Blue and Union mines.

Hay Fork district.—From the Switzerland mine some ore rich in gold was crushed in an arrastre.

Payette River district.—Placer gold valued at $649 and 6 ounces of silver were taken from the banks of Payette River.

West View district.—The production of this district was gold valued at $28,559, 3,645 ounces of silver, and 5,735 pounds of copper, with a total value of $31,256. Part of this output came from placers. The only large producer was the Whitman property, from which some crude ore and considerable concentrate were shipped. A 50-ton concentration mill was used, without amalgamation.

BONNER COUNTY.

The production of Bonner County was $844 in gold, 14,572 ounces of silver, 5,646 pounds of copper, and 7,218 pounds of lead, with a total value of $9,748. There was a decrease of 11,570 ounces in output of silver, the most important metal of the county. Ore amounting to 227 tons, at an average value of $42.94 per ton, was shipped or treated from 6 deep mines. The plant of the Idaho Smelting & Refining Co., at Ponderay, was idle the entire year.

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Most of the ore came from the Pend Oreille district, the Lakeview district being practically unproductive.

Pend Oreille district.—The B. F. & H., the Little Joe, and the Katherine mines, at Blacktail, produced silver ore of shipping grade; and the Midas Galena, at Midas, made one shipment of lead ore.

Priest Lake district.—The Farmer Jones Mining Co. treated a few tons of ore in a small Chilian mill. Development work done in the district is described in the Mining World of January 15, 1910. The Idaho Continental Mining Co., which has shipped good lead ore in the past, was constructing a concentration plant.

CANYON COUNTY.

From Payette and Snake rivers small lots of placer gold were obtained.

CASSIA COUNTY.

Stokes district.—The Alice mine, on Connor Creek, was productive of some lead ore, containing a good percentage of gold and silver.

CUSTER COUNTY.

The deep mines, 8 in number, produced 9,973 tons of ore, $17,771 in gold, 31,168 ounces of silver, 919,648 pounds of copper, and 19,086 pounds of lead, with a total value of $152,236. The placers, 11 in number, produced $5,286 in gold and 101 ounces of silver. There was a large increase in copper production, due to operations at the White Knob mine, and there was a falling off in gold yield at the Sunbeam property. About half the gold production came from siliceous ore, and the remainder was from placers and copper ore.

Alder Creek district.—Although the smelter of the Empire Copper Co. was idle, there was a large tonnage of low-grade copper ore shipped through lessees from the White Knob mine.

Bay Horse district.—The Dryden and the Homestake mines were productive of a small tonnage of rich lead ore and concentrate.

Loon Creek district.—Production in Loon Creek district was only $359 in placer gold and 3 ounces of silver. The Lost Packer smelter was idle, but the mine was being developed on the 1,000-foot level. The property is awaiting railroad facilities, but the Gilmore & Pittsburg Railroad was not extended during the year from Salmon through Lemhi and Custer counties.

Sea Foam district.— From the Golconda mine, on Sheep Mountain, were shipped a few tons of lead ore, as flux, to the small smelting plant connected with the Greyhound mine. At the latter mine, experiments were made with a 10-stamp mill, concentrators, and a 50-inch blast furnace. Some ore, concentrate, and matte are on hand, but no product was marketed, and the treatment was not deemed entirely successful.

Stanley Basin district.—This district produced $5,091 in gold and 111 ounces of silver, most of which was from 9 placers. The Joe's Gulch mine was the only important placer.

Yankee Fork district.—The district produced $12,104 in gold and 935 ounces of silver. This represents an unusually reduced output, as the Sunbeam Consolidated Gold Mines Co. marketed bullion only during the latter half of the year. The first part of the year was

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consumed in completing a dam on Salmon River and constructing the first 500-ton unit of a 2,000-horsepower hydraulic electric plant, which was described in the Salt Lake Mining Review of January 30, 1910.

ELMORE COUNTY.

The output of Elmore County was $180,282 in gold, 16,854 ounces of silver, and 15 pounds of copper, in all valued at $189,385, which is a decrease in value of county output of $12,036. The county was exceeded in gold output only by Boise and Owyhee counties. The decrease in production was occasioned by the closing of the Bagdad-Chase mine. There were 12 deep mines and 23 placers productive, but nearly all the gold was derived from siliceous ore. Almost all the ore, or 34,293 tons, was treated in gold and silver mills, resulting in $154,696 in gold and 9,866 ounces of silver in bullion, or $4.67 per ton in both metals. This ore also contained 290 tons of concentrates, valued at $25,165, or $86.78 per ton. Six gold and silver mills were active in 1910.

Bear Creek district.—Ten placers and 1 deep mine produced $3,348 in gold and 87 ounces of silver in Bear Creek district. At the Bonaparte mine, rich ore was treated from shallow workings in a 5-stamp mill.

Black Warrior district.—A small production of gold and silver was made from 3 deep mines and 1 placer.

Highland district.—From Twin Springs and points along Boise River small lots of gold dust were produced from placers.

Middle Boise district.—This, the most important district of the county, produced $127,818 in gold, 15,004 ounces of silver, and 15 pounds of copper, with a total value of $135,922, of which $826 in gold and 24 ounces of silver came from placers. The remainder came from 6 deep mines, which produced 29,546 tons of ore, valued at an average of $4.57 per ton. Practically all this ore was treated in 3 gold and silver mills. The Atlanta Mines Co. (Ltd.) marketed considerable bullion from May until the end of the year. The ore of this company is complex and difficult to treat, and the bullion contains a high percentage of silver. The mill has a capacity of 150 tons per day, but was only operated in an experimental way. The Bagdad-Chase mine, the largest producer in 1909, was closed in March, but the mill was run on tailings and considerable bullion was shipped. The Minerva mine took first place in the county in output of bullion. A 20-stamp mill and 6 Johnson concentrators were in constant operation, and a 10-stamp mill and concentrators were added in 1910. Unlike that of the Atlanta and Bagdad-Chase mines, the ore is largely free-milling. A few tons of ore were shipped from the East Atlanta mine as a test.

Neal district.—From the Homestake and Daisy property bullion and concentrate were shipped, but the greater part of the year was employed in constructing a new 10-stamp mill and 50-ton cyanide plant, and in sinking the shaft to the 600-foot level. This mine is in Elmore near the dividing line between Elmore and Ada counties.

Pine Grove district.—The C. H. Gold Mining Co. enlarged the mill to 10 stamps and shipped bullion from May until December.

Snake River district.—A small placer gold production was derived from Glenns Ferry and Heise.

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FREMONT COUNTY.

Unorganized district.—The Birch Creek Mining Co. made shipments of rich lead-silver ore, and stored the lower grade product for future treatment.

IDAHO COUNTY.

Mine production of gold and silver in Idaho County, Idaho, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	8,546.51	$176,672	2,201.89	$45,517	−6,344.62	−$131,155
Silver.....do....	7,155	3,721	1,588	858	− 5,567	− 2,863
PLACERS.						
Gold.....fine ounces..	1,390.62	28,540	888.55	18,368	− 492.07	− 10,172
Silver.....do....	266	138	156	84	− 110	− 54
Total.....	.....	209,071	.....	64,827	.....	− 144,244

The output of gold and silver in Idaho County was unusually low in 1910, with decreases from both placer and deep mines. The Buster mine, the largest producer in 1908 and 1909, was idle in 1910. There were 20 producing deep mines, from which 6,351 tons of ore were treated, with an average value in gold and silver of $7.30 per ton. There was a decrease in ore output of 19,414 tons in 1910. All the ore was siliceous, and was treated in 16 gold and silver mills, the value per ton being entirely that of bullion.

Big Creek district.—From the Moscow mine, near Edwardsburg, bullion was shipped.

Camp Howard district.—Four placers supplied $708 in gold and 4 ounces of silver in 1910.

Clearwater district.—From near Kooskia and Clearwater a placer product valued at $550 was gained.

Dixie district.—Three placers produced $465 in gold and 2 ounces of silver.

Elk City district.—From 9 deep mines and 9 placers $37,533 in gold and 1,435 ounces of silver were produced. This is a larger number of deep mines than that of 1909, but the largest producer, the Buster, was idle, causing a large decrease in the output of gold. Placers produced $3,005 in gold and 33 ounces of silver. The South Fork mine, the largest producer in 1910, was operated most of the year by the Elk City Mines Corporation. Bullion was shipped from a 5-stamp mill, and concentrate was made, but not marketed. Some bullion was also shipped from the American Eagle mine and from the Grangeville property, which was equipped with a 5-stamp mill. The Penn-Dixie Gold Mining Co. built a 4-stamp mill and made various tests throughout the year. The two dredges of the district were operated but little. Some notes on the Elk City district were published in the Mining World of January 8, 1910.

Florence district.—There was a placer production of $417 in gold and 7 ounces of silver in 1910.

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Marshall Lake district.—The Shamrock placer made a small production.

Newsome district.—Four placers and 3 deep mines produced $3,291 in gold and 31 ounces of silver, of which $1,953 in gold and 11 ounces of silver came from placers. The Iron Crown, the N. P., and the Virginia were producing quartz mines, and the Newsome, the Leggett Creek, and the Hill Top were the largest placer operators.

Orogrande district.—The Idaho-Champion, Iola, and Twin Butte deep mines produced $727 in gold and 21 ounces of silver. Work was largely development.

Robbins district.—At the Cracker Jack mine construction of a 20-stamp mill was completed and a short run was made in the fall. A few tons of concentrate were made, but not sold. The Jumbo mine, idle for two years, was leased in July and a slight production was made from the 60-ton mill.

Salmon River district.—From placers along Salmon River gold valued at $766 and 6 ounces of silver was saved.

Simpson district.—Gold valued at $1,548 and 6 ounces of silver were taken from 7 small placer operations.

Ten mile district.—The Tippie placer, 7 miles from Newsome, was a producer in 1910.

Thunder Mountain district.—This region was unproductive except from slight surface work.

Warren district.—Two deep mines and 9 placers produced $9,159 in gold and 120 ounces of silver. The Gott and Golden Rule mines supplied placer gold valued at $6,990 with 67 ounces of silver, and the White Monument mine produced bullion in a 3-stamp mill.

KOOTENAI AND LATAH COUNTIES.

Production from Kootenai and Latah counties was derived from placer gold and a small copper output, having a total value of $14,420. The Cedar Creek mine, at Tyson in Kootenai County, was the largest placer producer. There were small producing placers in the vicinity of Harvard, in Latah County; and in the Hoodoo district the Mispa and the Latah companies are developing copper ore, small shipments of which were made in 1910.

LEMHI COUNTY.

Mine production of gold, silver, copper, and lead in Lemhi County, Idaho, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	5,115.17	$105,740	2,466.26	$50,982	− 2,648.91	−$54,758
Silver.....do....	5,564	2,893	150,119	81,064	+ 144,555	+ 78,171
Copper.....pounds..	46,246	6,012	54,887	6,971	+ 8,641	+ 959
Lead.....do....	132,071	5,679	6,526,474	287,165	+6,394,403	+281,486
PLACERS.						
Gold.....fine ounces..	1,164.29	24,068	772.98	15,979	− 391.31	− 8,089
Silver.....do....	111	58	66	36	− 45	− 22
Total.....	.....	144,450	.....	442,197	.....	+297,747

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Source of gold and silver in Lemhi County, Idaho, in 1909 and 1910, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Total.
Gold	1909	1,164.29	5,096.04	15.10	4.03	6,279.46
	1910	772.98	2,189.19	.....	277.07	3,239.24
Silver	1909	111	607	1,678	3,279	5,675
	1910	66	355	.....	149,764	150,185

The total value of the county output was considerably increased as a result of the lead output from the Gilmore camp, from July to the end of the year, when the Gilmore & Pittsburg Railroad was in operation. There was a decrease in gold production from both quartz and placer operations. Thirteen placers, including 1 operated by dredge, supplied nearly 24 per cent of the gold output. From 22 deep mines 15,392 tons of ore were shipped or treated, 5,569 tons of which were treated in gold and silver mills, averaging in recovered value $7.84 per ton, and 9,823 tons were shipped as crude ore, averaging $38.84 per ton.

Eldorado district.—The Bohannon Bar placer made an important production, but was not worked to the extent of previous years.

Eureka district.—The only production of note was made by the Mullan dredge on Moose Creek.

Forney district.—Trial runs on ore were made at the Rabbit Foot mine.

Gibbonsville district.—The American Development, Mining & Reduction Co. produced bullion in a 20-stamp mill, and the Anderson placer also produced gold.

Indian Creek district.—The largest gold output of the county came from the Kittie Burton and the Ulysses mines. The 15-stamp mill was active from April to August.

Junction district.—The Junction mines were operated the entire year, producing silver-lead ore.

Leesburg district.—The output of the Leesburg district was placer dust valued at $2,237 in gold and containing 8 ounces of silver. The Richardson placer was the largest producer.

Mackinaw district.—Production amounted to $1,729 in gold and 21 ounces of silver. At the Italian mine a new stamp mill was erected, but little production was reported.

Mineral Hill district.—Bullion valued at $425 came from tests at the Clipper-Bullion, the Big Lead, and the Kentuck mines.

Parker Mountain district.—At the Parker Mining Co.'s property only small tests were made, the 6-ton roller mill being practically idle. The Ed Williams group produced a small trial lot of high-grade gold-silver ore.

Spring Mountain district.—The Lemhi Smelting Co. made a second short run in the 80-ton lead smelter on ore from the Red Warrior, Elizabeth, and Teddy mines.

Texas district.—From 6 deep mines, the Texas district made an putput of 8,993 tons of ore, containing gold valued at $5,630, 132,963 ounces of silver, 53,110 pounds of copper, and 5,981,012 pounds of lead, with a total value of $347,340. Nearly all the product was lead ore, with an average total value of $38.62 per ton. From the Pitts-

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burgh-Idaho property ore shipping began in July, and the output was increased until 50 tons of ore were being shipped daily in November. This mine and the Latest Out have brought Lemhi County to second place as a lead producer. The latter property made the largest production in its history. A railroad spur was constructed from Leadore to the mine, and shipments were made at the rate of about 20 tons per day during the last part of the year. Lead ore was also marketed from the Oriole, Hardscrabble, and Hughes mines, and several shipments of ore containing gold and silver were taken from the Allie property.

Yellow Jacket district.—Work at the Idaho-Yellow Jacket mine and the Grey Eagle property was principally development.

LINCOLN COUNTY.

Snake River district.—Placer product from Jerome and Clear Lake was valued at $353.

NEZ PERCE COUNTY.

From 25 producing properties, one of which was a deep mine, gold valued at $40,831 and 466 ounces of silver were recovered, a decrease of $4,692 in gold and 50 ounces of silver. Nearly all of the output was placer gold, a large percentage of which was won by dredging.

Burnt Creek district.—Five placers at Dent supplied $2,546 in gold and 29 ounces of silver. The Boise placer was the largest producer.

Pierce district.—The district supplied $37,376 in gold and 432 ounces of silver from 17 placers and 1 deep mine. The Idaho Co. (Ltd.), which has been carrying on dredging operations for 5 years, began in May the operation of the new 2,000-cubic yard dredge. The plant has close-connected buckets of a capacity of 3¾ cubic feet each, and the company is reported to have 150 acres of dredgable ground averaging 20 cents per cubic yard. The old dredge was idle. Other placers worked by hydraulicking were the Bay View, Hay Creek, Rhodes Creek, and Trail Creek.

Snake River district.—Placer output valued at $746 was produced by Chinese operators from the Snake River district.

ONEIDA COUNTY.

Snake River district.—Four placers made a production of $2,082 in gold and 10 ounces of silver at Aberdeen and Neeley.

OWYHEE COUNTY.

The production of this county, the largest gold producer of the State, was gold valued at $388,728 and 341,494 ounces of silver, a decrease of $36,577 in the former and of 305,903 ounces in the latter. With the exception of a slight placer output, the gold and silver was produced from siliceous ore. Eleven deep mines produced 50,297 tons of ore, valued at $11.38 per ton, a decrease of 5,036 tons from the output of 1909. Nearly all of the ore, or 50,288 tons, was treated in gold and silver mills, the average recovery per ton in bullion being

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$10.67. From this tonnage 91 tons of concentrates were made, having a total value of $29,554, or an average of $324.76 per ton.

Carson district.—The production of this district, practically that of the county, was gold valued at $388,268 and 341,489 ounces of silver, a considerable decrease from the output of 1909. The general decrease in the district and county output was the result of the closing of the Trade Dollar mill in March. For many years this was one of the largest gold-silver producers of the State, but the ore became low grade at depth. The De Lamar mine and 150-ton cyanide plant were operated the entire year, and, according to published statements, produced bullion valued at more than a half a million of dollars. A dividend of $40,000 was issued in October. The only other producer of note in the district was the Bergh Mining Co., which erected a 5-stamp mill and operated during 6 months of the year, producing bullion and concentrate.

Snake River district.—Placer product from near Oreana was valued at $463.

SHOSHONE COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Shoshone County, Idaho, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	3,658.65	$75,631	2,711.85	$56,059	− 946.80	−$19,572
Silver.....do....	6,201,045	3,224,544	6,703,005	3,619,623	+ 501,960	+395,079
Copper.....pounds..	8,906,944	1,157,903	6,018,688	764,373	−2,888,256	−393,530
Lead.....do....	213,558,658	9,183,022	219,758,042	9,669,354	+6,199,384	+486,332
Zinc.....do....	1,280,000	69,120	5,526,717	298,443	+4,246,717	+229,323
PLACERS.						
Gold.....fine ounces..	666.95	13,787	436.20	9,017	− 230.75	− 4,770
Silver.....do....	112	58	75	41	− 37	− 17
Total.....	.....	13,724,065	.....	14,416,910	.....	+692,845

Source of gold and silver in Shoshone County, Idaho, in 1909 and 1910, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Gold.....	1909	666.95	39.38	1,124.96	2,494.31	.....	4,325.60
	1910	436.20	.....	492.13	2,219.72	.....	3,148.05
Silver.....	1909	112	76	594,824	5,602,395	3,750	6,201,157
	1910	75	.....	446,471	6,238,518	18,016	6,703,080

Shoshone County produced over 88 per cent of the State output in point of value, and made significant increases in production of all metals but copper and gold. There was a steady increase in lead production, aided by the Stewart and Caledonia mines, and a large increase in output of zinc concentrate. There were 39 producing mines, 14 of which were placers. From 25 deep mines, 1,639,781 tons of ore were treated or shipped, most of which was concentrated. Ore

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sent to concentration mills (1,526,744 tons) made 195,338 tons of concentrates, valued at $10,573,060, or $54.13 per ton. The crude ore shipped (112,434 tons) was valued at $3,834,792, or $34.11 per ton. Fourteen concentration mills, varying in capacity from 50 to 1,000 tons per day and having a total daily capacity of 6,010 tons, were active. Over 70 per cent of the gold and 93 per cent of the silver in the county had their source in the lead ore. The situation in the Cœur d'Alene district is described in the Engineering and Mining Journal of January 7, 1911, page 18, as follows:

> The increased cost of production, higher supply costs, deeper mines, lower metal markets, and decrease in grade of ore were more serious factors during 1910 in cutting into profits than were ore failures. These factors will continue to be adverse. Several individual mines will continue to make handsome profits for many years, but for the district as a whole the top figure for financial return has without doubt been passed, and unless some new, important, regular producers are added, either by fortunate discovery or by development of some known and at present unimportant property, the production will by natural laws recede year by year from the magnificent recent annual outputs.

A series of articles on "Ore dressing in the Cœur d'Alene district" appeared in the Engineering and Mining Journal during 1910.

Beaver district.—Most of the placer gold of the county comes from this district, north of Wallace. One deep mine and 9 placers were productive. The placer output, which decreased in 1910, was $5,636 in gold and 56 ounces of silver. The Black Hill and the New Year were the most productive properties. From the Callahan mine, shipments of rich lead-silver ore were made. The Idora, a former shipper, was unproductive.

Cœur d'Alene district.—The Grove and Walker placer in Daisy Gulch was productive on a small scale.

Eagle district.—Three placers produced $2,650 in gold and 16 ounces of silver.

Hunter district.—From this region around Mullan $20,358 in gold, 1,208,958 ounces of silver, 5,132,839 pounds of copper, and 34,319,319 pounds of lead, with a total value of $2,835,116, were produced, a decreased output in all metals, but principally in copper. The ore production from 6 mines was 496,928 tons, of which 432,010 tons were reduced to 41,247 tons of concentrates, valued at $45.77 per ton, and 64,585 tons were crude shipping ore. The Alice Mining Co., east of Wallace, continued to operate the mill and shipped concentrates until July, when the mine was worked by lessees. At the Morning mill 1,000 tons of ore were being treated daily throughout the year. Development work, aggregating 2,500 feet, was accomplished. At the end of the 2-mile tunnel a large station was completed, and from the tunnel level a shaft was sunk 200 feet where the ore was reported of better grade. In the company report issued August 31, 1910, the statement was made that at the Morning mine metallurgical difficulties were encountered. The ore reserve was reported as 543,000 tons. Experiments were in progress with Macquiston tubes, as the recovery on lead ore carrying 7 to 8 per cent of lead was only 60 per cent. The management recommended the mine closed unless the recovery could be increased to 80 per cent. From this property and the Mace and Wardner mines, the Federal Mining & Smelting Co. declared dividends amounting to $630,000 on the preferred stock. According to the county figures, 333,900 tons of ore were extracted from the Morning mine, having a gross value of $1,203,013. Cost of mining and reduc-

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tion was given as $1,243,812, and the net loss as $40,799. The Gold Hunter mine again produced more lead concentrates than during any previous year. A 300-ton concentrator was active the entire year, and development with good results was pursued below the No. 6 tunnel level, where the ground is less flinty and a better saving can consequently be made in concentration. A new electric hoist was ordered the last part of the year. The Snow Storm Mining Co. continued the shipment of siliceous ore, containing copper and silver, to the Tacoma, Balaklala, Granby, East Butte, Butte Reduction, Mammoth, Murray, and Boston & Montana plants. According to the county figures, 62,700 tons of ore were extracted, having a gross value of $676,076. Cost of extraction was given as $164,289; transportation, reduction, and sale, $358,730; betterments and repairs, $33,381; total operation, $556,399; and net profits, $119,677. Dividends aggregating $180,000 were declared in 1910. In April shipments were being made at the rate of 8,000 tons per month, but at the close of the year production was greatly curtailed. Some copper ore from the Reindeer mine was jigged and shipped to Tacoma, and several feet of copper ore were said to have been opened in the Missoula Copper Co.'s property.

Lelande district.—From seven mines at Burke, Mace, and Gem 412,614 tons of ore were mined, containing gold valued at $20,411, 2,822,789 ounces of silver, 382,311 pounds of copper, and 72,840,963 pounds of lead, in all valued at $4,798,272. Of the ore, 30,486 tons were shipped crude and 381,858 tons were reduced to 48,749 tons of concentrates, having a gross value of $60.09 per ton. This was a slight decrease from the 1909 output. The Federal Mining & Smelting Co. owns at Burke a 500-ton concentrator, which was leased by the Hercules Mining Co., and a 1,050-ton plant, near Wallace, used to concentrate ore from the company's Mace mines and ore from the Stewart mine at Wardner. According to the county figures, 201,350 tons of ore were extracted from the Mace mines, having a gross value of $1,852,282. Cost of reduction was given as $740,515; transportation, reduction, and sale, $550,834; betterments and repairs, $67,494; total operation, $1,358,895; and net profits, $494,439. In January fire destroyed the ore bins and equipment at the mouth of No. 6 tunnel at the Mace mines. In February a snowslide delayed work several days and blocked shipments. In August this and many other mines of the Cœur d'Alene region were similarly handicapped by the forest fires. With the exception of a few days, the Hecla mine and mill were worked continuously. Production was slightly less than in 1909. Excluding the year 1908, production has remained much the same in the last six years. The mine is being opened on the 1,200-foot level and the electric hoist has been successfully used. According to the county figures, 129,480 tons of ore were extracted, having a gross value of $950,849. Cost of extraction was given as $402,703; transportation, reduction, and sale, $320,899; betterments and repairs, $10,373; total operation, $733,939; and net profits, $216,909. Dividends were $180,000. In spite of the fact that the Hercules Mining Co. consumed time in equipping the Tiger mill, which it leased and used in 1910, more lead was produced than in any year in the mine's history. A new 100-horsepower electric hoist was used in the mine and about 300 tons of ore were sent to the mill daily, while much first-class ore was sorted and shipped without

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treatment. In November ground was broken for a new 400-ton mill near Wallace to take the place of the mill burned at Burke in 1909. According to the county figures, 25,765 tons of ore and concentrate were sold, having a gross value of $1,249,081. Cost of extraction was given as $142,420; transportation, $178,503; reduction and sale, $195,623; betterments and repairs, $313,992; total operation, $830,539; and net profits, $418,542. A few shipments of lead ore were taken from the upper workings of the Frisco mine by lessees and a little concentrate from old creek tailings was shipped.

Placer Center district.—The production, largely silver, lead, and zinc, from this district had a total value of $365,482, an increase from $83,063 in 1909. A considerable outlay was made for the continued development of the Rex or "16 to 1" mine. The shaft is down 500 feet below a 1,600-foot tunnel. A 250-ton mill, to which equipment for sliming was added in 1910, was operated part of the year and both concentrate and crude ore were shipped. At the Success mine a larger quantity of zinc concentrate was shipped than ever before. A 150-ton concentrator also produces a lead-silver product. A mill run of 150 tons is said to make 30 tons of zinc concentrate and about 3 tons of lead concentrate. The State report credits the mine with an output of 5,995,600 pounds of zinc. According to the county figures, 8,471 tons of concentrate were made, having a gross value of $134,956. Cost of extraction, sale, etc., was given as $124,906, and net profits, $10,049.

St. Joe district.—A small production of gold was made from the Golden Gate placer at the headwaters of St. Joe River. The Big Elk Mining Co. made a trial shipment of copper ore and the Monitor mine, south of Saltese, was productive of ore containing gold, silver, and copper. This is a rugged country, which will have improved chance of development with the operation of the Chicago, Milwaukee & Puget Sound Railway.

Summit district.—This region, near Murray, had a production of gold valued at $118, 7,744 ounces of silver, 2,097 pounds of copper, and 1,359,924 pounds of lead, with a total value of $64,403, or about the same as that of 1909. A 150-ton concentration plant was in course of construction for the Black Horse mine. Lead concentrates and crude ore were shipped from both the Bear Top and the Monarch mines. At the latter property a 200-ton concentration plant was completed, including rolls, jigs, Huntington mill, Wilfley tables, and Frue vanners. A 40-ton sampling mill was used during the year.

Yreka district.—From five mines near Wardner 679,934 tons of ore were milled or shipped, containing $14,925 in gold, 2,626,802 ounces of silver, 488,635 pounds of copper, and 109,899,539 pounds of lead, with a total value of $6,331,035. This represents an increase for 1910 of $909,170, due to shipments from the Bunker Hill & Sullivan, Caledonia, and Stewart mines. Of the total ore output, 663,018 tons were milled, making 95,426 tons of concentrate, valued at $55.76 per ton, and 16,916 tons, valued at $59.72 per ton, were shipped crude. The Bunker Hill & Sullivan property maintained the exceptional production of 70,000,000 pounds of lead and 1,245,000 ounces of silver, according to the State report. This is a substantial increase over the output of 1909, as the mills, aggregating 1,350 tons, were operated the entire year. A 1,000-ton plant for the re-treatment of tailings was completed and successfully operated. Dividends

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amounting to $925,350 were distributed. According to the county figures, 425,160 tons of ore were extracted, having a gross value of $3,514,431. Cost of extraction was given as $1,023,095; transportation, reduction, sale, etc., $1,350,205; total operation, $2,373,300; and net profits, $971,263. The new concentrator of the company is described in the Mining and Scientific Press of January 15, 1910, and in Mining Science of June 23, 1910. At the Last Chance mine, of the Federal Mining & Smelting Co., the 500-ton mill was active the greater part of the year, but a decreased production was recorded. The differences between this company and the Bunker Hill & Sullivan Co. were settled during the year. In September the ore reserve was said to be 313,600 tons, or equivalent to about two years' supply. According to the county figures, 191,500 tons of ore were extracted, having a gross value of $1,765,188. Cost of extraction was given as $972,271; transportation, reduction, sale, etc., $551,614; total operation, $1,528,885; and net profits, $285,303. In July the Stewart Mining Co. began the shipment of lead ore to the Mammoth mill, at Wallace, for concentration and continued shipping at the rate of 200 tons per day. The mill owned by the Stewart Co., about which there was litigation, was not used. According to the county figures, 55,346 tons of ore were extracted, having a gross value of $327,790. Cost of extraction was given as $113,582; transportation, $13,933; smelter charges and freight, $108,221; milling at Wallace, $29,374; betterments and repairs, $40,891; total operation, $306,001; and net profits, $21,789. The Caledonia Mining Co. continued the shipment of crude ore, rich in silver and lead and containing a larger percentage of copper than other Coeur d'Alene properties. From 20 to 30 tons per day of a hand-sorted product were shipped, and dividends amounting to $52,000 were paid. The property is worked through a 500-foot incline shaft, but a 2,800-foot tunnel now in 800 feet is to be driven to open the mine 700 feet below the foot of the shaft. The county figures give 8,078 tons of ore extracted, having a gross value of $479,307. Cost of extraction was given as $136,262; transportation, reduction, sale, etc., $184,632; total operation, $320,894; and net profits, $165,597. The Surprise Mining Co. made a few shipments of first-class ore. The 50-ton mill was not used.

TWIN FALLS COUNTY.

Snake River district.—Placer gold valued at $1,559, and 3 ounces of silver was taken from the Klondyke, Bonanza, Homestake, and Last Chance claims.

WASHINGTON COUNTY.

Five small placers and 6 deep mines in Washington County made a production of 504 tons of ore, $3,600 in gold, 124 ounces of silver, and 4,943 pounds of copper, with a total value of $4,295. The total value decreased $1,739 in 1910.

Seven Devils district.—Gold valued at $3,074, 118 ounces of silver, and 4,943 pounds of copper were produced from copper ore and siliceous ore. The Idaho Gold Coin Mining & Milling Co., a producer in 1903, 1904, and 1905, again made a shipment of fine bullion, through the operation of a 50-ton cyanide plant. Other producing

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properties supplying small shipments of copper ore were the Calumet-Buena Vista, National, Landore, and Trevor.

Unorganized district.—In the vicinity of Meadows a small production of placer gold was reported.

MONTANA.

By V. C. Heikes.

PRODUCTION.

There were 578 producing mines in Montana reporting the production of metal in 1910. Of the total number, 155 were placers. The combined yield of gold, silver, copper, lead, and zinc was valued at $48,358,253. Lode mines in 19 counties and 79 districts yielded ore valued at $47,780,664, and placers in 14 counties and 45 districts produced gold and silver bullion valued at $577,589. Copper was produced in 1910 valued at $36,170,686, which was over 74 per cent of the total value of the metal output. In 1909 the total copper yield was valued at $40,567,541 and formed about 79 per cent of the total. The total silver output, which was largely the product of copper ores in 1910, was 12,162,857 ounces, or 215,857 ounces less than in 1909. Silver Bow County mines, producing principally copper, yielded in quantity 21 per cent of the gold, 83 per cent of the silver, and 99.8 per cent of the copper. Gold in 1910 was produced in greatest quantity, about 22 per cent, in Madison County, and was largely the output of placers. Concentration mills treated 4,170,114 tons of ore, yielding 1,281,319 tons of concentrate, which were shipped to smelters, containing gold, silver, copper, lead, and zinc, valued at $35,016,059, or an average value of $27.33 per ton. The larger part, or 67 per cent of the silver and 99 per cent of the zinc were contained in concentrate. Crude ores of shipping grade aggregating 616,596 tons, valued at $10,638,348, or an average value of $17.25 per ton, were shipped to smelters and yielded the larger part, or 29 per cent, of the gold, 20 per cent of the copper, and 83 per cent of the lead. At milling plants, using principally the cyanide process, gold and silver bullion was produced from the treatment of 266,689 tons of ore and 12,134 tons of old tailings, both of which averaged $5.36 per ton. Old smelter cleanings, aggregating 13,913 tons, and copper precipitates from mine waters and tailings added to the total output. The statement of production for 1909 and 1910, showing increase and decrease and valued at each year's commercial prices, is as follows:

Mine production of gold, silver, copper, lead, and zinc in Montana in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	183,414.30	$3,791,510	180,462.26	$3,730,486	− 2,952.04	− $61,024
Silver.....do....	12,378,714	6,436,931	12,162,857	6,567,942	− 215,857	+ 131,011
Copper.....pounds..	312,058,011	40,567,541	284,808,553	36,170,686	−27,249,458	−4,396,855
Lead.....do....	2,983,430	128,287	4,106,292	180,677	+ 1,122,862	+ 52,390
Zinc.....do....	9,359,724	505,425	31,638,184	1,708,462	+22,278,460	+1,203,037
Total.....	.....	51,429,694	.....	48,358,253	.....	−3,071,441

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Montana's production of ore and its content for seven years is as follows:

Tons of ore sold or treated in Montana in 1904–1910, and total content of gold, silver, copper, lead, and zinc.[a]

Year.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1904	4,643,092	206,419.45	12,817,285	290,681,572	2,299,291	.....	$48,974,381
1905	5,020,137	231,913.75	13,231,300	304,723,526	6,264,998	1,560,000	60,709,155
1906	5,497,971	216,188.56	11,980,705	290,700,975	4,462,979	6,579,000	69,257,083
1907	4,148,496	158,970.51	9,317,605	220,108,792	3,748,304	243,100	53,670,592
1908	4,266,022	147,913.33	10,356,199	251,667,795	4,596,570	1,640,000	42,036,710
1909	5,421,185	183,414.30	12,378,714	312,058,011	2,983,430	9,359,724	51,429,694
1910	5,079,446	180,462.26	12,162,857	284,808,553	4,106,292	31,638,184	48,358,253

[a] Includes placer production in each year.

ORE PRODUCTION IN 1910.

The production of 5,079,446 tons of ore in 1910 shows a decrease of 341,739 tons in quantity, but an increase in total value per ton from $9.39 in 1909 to $9.41 per ton in 1910, and the gold and silver value increased from $1.79 to $1.91. Silver Bow County mines produced the largest tonnage of ore, aggregating 4,709,429 tons, of which nine-tenths was copper ore, 169,165 tons zinc ore, 23,384 tons siliceous ore, 423 tons lead ore, and 140 tons copper-lead ore. Fergus and Chouteau County mines yielded the largest quantity of siliceous ores, which contained principally gold and silver. Production of siliceous or dry ores decreased in quantity from 416,329 tons in 1909 to 385,067 tons in 1910. In Broadwater County, at Radersburg, the ores are largely sulphides of iron. Production of copper ore decreased from 4,965,001 tons in 1909 to 4,517,709 tons in 1910; of lead ore increased from 4,678 tons in 1909 to 5,951 tons in 1910; of zinc ore increased from 34,463 tons in 1909 to 169,165 tons in 1910; of copper-lead ore increased from 610 tons in 1909 to 1,524 tons in 1910; and of lead-zinc ore decreased from 104 tons in 1909 to 30 tons in 1910. The average yield per ton of gold and silver in dry or siliceous ores in 1910 was $9.19, as against $7.86 in 1909; in copper ore, $1.24, as against $1.23 in 1909; in lead ore, $27.83, as against $21.61 in 1909; in zinc ore, $2.23, as against $4.28 in 1909; and in copper-lead ore, $31.22, as against $42.92 in 1909. The lead-zinc ore produced in 1910 was from one property in Fergus County.

Subdivision of tonnage of ore sold or treated in Montana in 1910, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaverhead	23	55	549	.....	365	.....	992
Broadwater	14,203	124	556	.....	.....	.....	14,883
Cascade	774	.....	579	.....	28	.....	1,381
Chouteau, Flathead, and Lincoln	56,516	26	114	.....	.....	.....	56,656
Deer Lodge	5,604	.....	.....	.....	.....	.....	5,604
Fergus	145,658	.....	59	.....	.....	30	145,747
Granite	6,615	10	120	.....	.....	.....	6,745
Jefferson	54,991	856	1,336	.....	88	.....	57,271
Lewis and Clark	44,513	1	947	.....	49	.....	45,510
Madison	31,230	34	457	.....	.....	.....	31,721
Meagher, Park, and Ravalli	9	43	157	.....	51	.....	260
Missoula and Sanders	1,217	28	553	.....	386	.....	2,184
Powell	330	215	101	.....	417	.....	1,063
Silver Bow	23,384	4,516,317	423	169,165	140	.....	4,709,429
Total	385,067	4,517,709	5,951	169,165	1,524	30	5,079,446
Value per ton in gold and silver	$9.19	$1.24	$27.83	$2.23	$31.22	.....	$1.91

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GOLD.

The decrease of gold output in 1910 may be credited to the dry or siliceous ores and copper ores, as the total recovered from placers, lead ores, zinc ores, and copper-lead ores increased. Most of the gold came from mines in Madison, Silver Bow, Fergus, Chouteau, and Broadwater counties. The greatest increase was in the output of Madison County; other increases were in Broadwater, Lewis and Clark, Beaverhead, and Jefferson counties. In 1910, Montana mines produced 180,462.26 fine ounces of gold, valued at $3,730,486. Compared with the figures of 1909, this indicated a decrease of $61,024. Milling plants equipped for treating the ores by the cyanide process and by amalgamation extracted 68,843.19 fine ounces from 266,689 tons of ore and 12,134 tons of old tailings, averaging $5.10 per ton. At milling plants equipped only for concentration, 4,170,114 tons of ore were treated, yielding 1,281,319 tons of concentrates, containing 31,589.38 ounces of gold, valued at $653,010, or an average value per ton of 51 cents. The concentrates were of three kinds, copper, lead, and zinc. Copper concentrates in largest quantities were produced at mills near Anaconda, in Deer Lodge County. The average value per ton in gold in 1909 was 54 cents and in 1908 was 58 cents.

Smelting ores shipped directly to the smelters aggregated 616,596 tons, yielding 52,043.17 ounces of gold, valued at $1,075,827, or an average value per ton of $1.74, against $1.58 in 1909. Gold production from placers increased from $543,372 in 1909 to $575,917 in 1910. Madison County placers produced the largest quantity of placer gold. This county may be expected in 1911 to make a further increase in production by the addition of additional dredges in Alder Gulch. The gold yield from siliceous ores decreased from 116,703.59 ounces in 1909 to 115,261.06 ounces in 1910; and from copper ores from 38,001.72 ounces to 31,441.93 ounces. Gold production from lead ores increased from 1,666.33 ounces in 1909 to 4,491.71 ounces in 1910, from zinc ores from 694.93 ounces to 1,023.17 ounces, and from copper-lead ores from 62.11 ounces to 384.41 ounces. Dry and siliceous ores averaged per ton $6.19; copper ores, 14 cents; lead ores, $15.59; zinc ores, 12 cents; and copper-lead ores, $5.87.

Source of gold production in Montana, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	
Beaverhead	81.90	16.67	0.53	2,651.44	.....	11.92	2,762.46
Broadwater	257.40	14,969.93	29.29	317.96	.....	.....	15,574.58
Cascade	.....	61.42	.....	43.55	.....	.....	104.97
Chouteau, Flathead, and Lincoln	89.68	24,465.06	.....	11.97	.....	.....	24,566.71
Deer Lodge	97.62	6,501.55	.....	.....	.....	.....	6,599.17
Fergus	.....	30,800.46	.....	2.42	.....	.....	30,802.88
Granite	524.29	3,345.95	.22	20.97	.....	.....	3,891.43
Jefferson	217.98	5,641.05	193.81	391.40	.....	23.93	6,468.17
Lewis and Clark	632.89	8,271.06	.....	294.21	.....	36.75	9,234.93
Madison	22,553.49	16,056.33	52.76	565.73	.....	.....	39,228.31
Meagher, Park, and Ravalli	139.85	9.05	.....	39.45	.....	26.53	214.88
Missoula and Sanders	1,749.34	171.42	10.63	.....	.....	1.48	1,932.87
Powell	1,394.70	309.09	11.02	85.39	.....	266.33	2,066.53
Silver Bow	120.84	4,642.00	31,143.67	67.22	1,023.17	17.47	37,014.37
Total	27,859.98	115,261.06	31,441.93	4,491.71	1,023.17	384.41	180,462.26

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SILVER.

The yield of silver in Montana in 1910 was 12,162,857 fine ounces, valued at $6,567,942, a decrease of 215,857 ounces. Silver is largely produced as the by-product from copper ores, and its increase in production largely depends on the increase in output of copper and siliceous ores. The silver yield from siliceous ores in 1910 was 2,139,465 ounces, an increase of about one-fourth over the quantity produced from the same source in 1909. The greatest increase was in Silver Bow County. Copper ores yielded 9,153,590 ounces of silver, which is 1,127,456 ounces less than the production of 1909. Nearly all of the output of 1910 was from ores mined from the Butte properties. Lead ores yielded 134,798 ounces, zinc ores, 658,516 ounces; and copper-lead ore, 73,391 ounces. The silver yield from lead ores was 6,619 ounces greater, from zinc ores 402,060 ounces greater, and from copper-lead ores 25,504 ounces greater than in 1909. Dry and siliceous ores averaged per ton 5.5 ounces; copper ores, 2.02 ounces; lead ores, 22.65 ounces; zinc ores, 3.89 ounces; and copper-lead ores, 48.15 ounces. The crude ore treated at smelters, 616,596 tons in quantity, yielded 3,766,375 ounces of silver, averaging 6.1 ounces per ton. Ore and tailings treated at amalgamation and cyanide mills aggregated 278,823 tons and yielded 130,190 ounces of silver, or an average of 0.47 of an ounce per ton. At concentration mills in eight counties 1,281,319 tons of concentrates were made, containing 8,208,644 ounces of silver, or an average of 6.4 ounces per ton. Silver Bow County concentrates produced most of the silver, and Jefferson County was second in total yield.

Source of silver production in Montana, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	
Beaverhead	8	1,545	93	9,428	.....	40,575	51,649
Broadwater	27	4,648	122	16,683	.....	.....	21,480
Cascade	.....	19,960	.....	36,606	.....	494	57,060
Chouteau, Flathead, and Lincoln	17	45,083	216	582	.....	.....	45,898
Deer Lodge	20	29,582	.....	.....	.....	.....	29,602
Fergus	.....	8,851	.....	432	.....	.....	9,283
Granite	143	303,434	1,017	3,829	.....	.....	308,423
Jefferson	38	988,690	11,857	27,703	.....	1,291	1,029,579
Lewis and Clark	99	44,576	12	13,767	.....	539	58,993
Madison	2,468	109,826	27	3,424	.....	.....	115,745
Meagher, Park, and Ravalli	17	2	12	2,267	.....	2,139	4,437
Missoula and Sanders	78	43	42	7,983	.....	5,576	13,722
Powell	164	1,040	659	5,084	.....	9,199	16,146
Silver Bow	18	582,185	9,139,533	7,010	658,516	13,578	10,400,840
Total	3,097	2,139,465	9,153,590	134,798	658,516	73,391	12,162,857

COPPER.

In 1910 the output of copper amounted to 284,808,553 pounds, valued at $36,170,686. As compared with the figures of 1909, this showed a decrease of 27,249,458 pounds, which is almost entirely credited to Silver Bow County mines, Jefferson County showing the next notable decrease. Silver Bow, Broadwater, and Jefferson

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counties, named in order of their production were credited with the greatest yield of copper. Nine counties out of 19 had decreases recorded against them for 1910. Ninety-nine per cent of the production of copper, or 284,264,862 pounds, valued at $36,101,638, was from the mines in Silver Bow County. The crude shipping ores treated at smelters in 1910, aggregating 616,596 tons, yielded 57,974,472 pounds of copper, or an average of 94.02 pounds per ton. Included in this crude ore to smelters was the 13,913 tons of old smelter cleanings, from which were recovered 171,564 pounds of copper. There were also 4,558,847 pounds of copper recovered from tailings by leaching and the use of scrap iron as a precipitant. The total quantity of concentrates produced in Montana was 1,281,319 tons, of which all but a small tonnage containing lead produced in Jefferson, Madison, and Missoula counties yielded 222,103,670 pounds of copper, or an average of 173.33 pounds per ton. In the classification of the kinds of ore produced in 1910, the copper ores carried the bulk of the copper. Siliceous ores yielded 674,587 pounds, of which 470,544 pounds were from ores mined in Silver Bow County. The average content of copper was 1.75 pounds per ton. Lead ores contained 15,390 pounds, averaging 2.58 pounds per ton; zinc ores contained 917,484 pounds, an average of 5.42 pounds per ton; and copper-lead ores contained 128,127 pounds, an average of 84.07 pounds per ton. Copper was associated with the lead ores produced in Silver Bow, Jefferson, Beaverhead, Broadwater, Fergus, and other counties. The copper-lead ores were produced in Beaverhead, Powell, Sanders, Silver Bow, and other counties.

Source of copper production in Montana by kinds of ore, in 1910, by counties, in dry pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Beaverhead	179	13,958	2,701	.....	42,475	59,313
Broadwater	64,710	57,681	2,547	.....	.....	124,938
Cascade	16,410	.....	91	.....	1,914	18,415
Chouteau, Flathead, and Lincoln	.....	18,183	118	.....	.....	18,301
Deer Lodge	4,822	.....	.....	.....	.....	4,822
Fergus	125	.....	1,042	.....	.....	1,167
Granite	17,649	1,178	40	.....	.....	18,867
Jefferson	62,359	50,214	6,107	.....	3,429	122,109
Lewis and Clark	1,268	46	773	.....	2,219	4,306
Madison	36,001	2,574	584	.....	.....	39,159
Meagher, Park, and Ravalli	.....	12,730	226	.....	2,833	15,789
Missoula and Sanders	69	6,096	.....	.....	30,573	36,738
Powell	451	45,487	.....	.....	33,829	79,767
Silver Bow	470,544	282,864,818	1,161	917,484	10,855	284,264,862
Total	674,587	283,072,965	15,390	917,484	128,127	284,808,553

LEAD.

The output of lead increased from 2,983,430 pounds, valued at $128,287, in 1909, to 4,106,292 pounds, valued at $180,677, in 1910, the greatest increase being from Jefferson, Missoula, Silver Bow, Cascade, Broadwater, and Park counties. The largest production was in Jefferson County, which yielded 1,975,492 pounds, and Silver Bow County ranked next with 350,173 pounds. Crude ore shipped to smelters contained 3,397,819 pounds, or eight-tenths of the total output. Concentrates contained lead aggregating 708,355 pounds.

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The concentrates were produced in Jefferson, Lincoln, Missoula, Madison, and Silver Bow counties. The mines in Jefferson County were productive of the largest total lead yield from siliceous ores.

Source of lead production in Montana, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaverhead	.....	.....	82,627	.....	191,358	.....	273,985
Broadwater	1,181	.....	244,754	.....	.....	.....	245,935
Cascade	226,272	.....	65,216	.....	7,001	.....	298,489
Chouteau, Flathead, and Lincoln	6,423	.....	20,182	.....	.....	.....	26,605
Fergus	.....	.....	51,254	.....	.....	9,000	60,254
Granite	2,974	.....	23,347	.....	.....	.....	26,321
Jefferson	1,644,011	.....	324,889	.....	6,592	.....	1,975,492
Lewis and Clark	1,021	20	174,626	.....	21,216	.....	196,883
Madison	39,251	.....	204,292	.....	.....	.....	243,543
Meagher, Park, and Ravalli	.....	.....	151,730	.....	44,089	.....	195,819
Missoula and Sanders	163	.....	92,523	.....	72,066	.....	164,752
Powell	.....	.....	16,485	.....	31,556	.....	48,041
Silver Bow	50,761	.....	64,097	136,578	98,737	.....	350,173
Total	1,972,057	20	1,516,022	136,578	472,615	9,000	4,106,292

ZINC.

The output of zinc figured as spelter aggregated 31,638,184 pounds, valued at $1,708,462 in 1910, as against a yield of 9,359,724 pounds, valued at $505,425 in 1909. In 1908 the output was 1,640,000 pounds. A great deal of attention has been paid to the development of zinc output within the last two years, especially so during the year 1910, and operations have passed from the experimental stage to that of production upon a fairly large scale. Large bodies of zinc ore have been found at a number of points in the Butte district. Nearly all the zinc contained in concentrate was shipped in 1910 to eastern plants and was the yield of the Butte Reduction Works, at Butte, and the Basin Reduction Works at Basin. These plants treated the ores of the Elm Orlu and Black Rock mines, respectively. In Fergus County a small production of zinc was reported.

MINING INDUSTRY IN MONTANA IN 1910.

The consolidation of the great copper mines at Butte was the most important event in 1910. The Anaconda Copper Co. now operates the mines formerly operated by the Boston-Montana, Red Metal, Washoe, Butte & Boston, Trenton, Parrot, Alice Gold & Silver, and Original Mining Cos. The Anaconda Co. thus becomes the only operating company of importance in the Butte district, with the exception of the North Butte, East Butte, Tuolumne, and Butte & Balaklava companies. Following the absorption came a general reduction in the production of the Butte mines, the production continuing at the reduced rate during the remainder of 1910. Large ore bodies are reported to have been encountered at depth in the mines of Butte during 1910, and the discoveries have not been confined to any one portion of the district. The most gratifying feature of the developments is the fact that the ore bodies encountered have been found on the deepest levels of the mines, and that the grade of the ore is far superior to that which occurred in many of the upper levels. In many instances the companies mining had no knowledge of the existence of these ore bodies, nor was it to be gained by the workings on

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the upper levels, as in some cases the ore bodies occur in apparently disconnected masses, while in others they appear in vein form in fissures which were known to be barren nearer the surface.

Especially important discoveries of gold and silver were made during 1910 in Deer Lodge and Granite counties. The Southern Cross mine in the Georgetown district produced some ore, but most of the work was confined to development. At the Oro Fino mine in this district the most important ore bodies were opened by lessees. Numerous other properties produced in a small way. Lincoln County, which had previously not been recognized as a great gold producer, was the scene of much mining activity. In August the forest fires, which swept that part of the State, destroyed the surface plants of a number of properties, which were rebuilt, however, before the end of 1910. Dredging operations were confined to Alder Gulch in Madison County and Cedar Creek in Missoula County. The dredge on Cedar Creek was damaged by forest fire and ceased operations. Operators of the British-Butte, a dredging venture near Butte, did prospecting work the early part of 1910 with a prospecting drill to a depth of 1,305 feet without striking bedrock, and then suspended operations.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1910, by counties.

County.	Gold.				Silver.	
	Placers.		Deep mines.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Fine ozs.*	
Beaverhead	81.90	$1,693	2,680.56	$55,412	51,649	$27,890
Broadwater	257.40	5,321	15,317.18	316,634	21,480	11,600
Cascade			104.97	2,170	57,060	30,812
Chouteau, Flathead, and Lincoln	89.68	1,854	24,477.03	505,985	45,898	24,784
Deer Lodge	97.62	2,018	6,501.55	134,399	29,602	15,985
Fergus			30,802.88	636,752	9,283	5,013
Granite	524.29	10,838	3,367.14	69,605	308,423	166,548
Jefferson	217.98	4,506	6,250.19	129,203	1,029,579	555,972
Lewis and Clark	632.89	13,083	8,602.04	177,820	58,993	31,856
Madison	22,553.49	466,222	16,674.82	344,699	115,745	62,502
Meagher, Park, and Ravalli	139.85	2,891	75.03	1,551	4,437	2,398
Missoula and Sanders	1,749.34	36,162	183.53	3,794	13,722	7,410
Powell	1,394.70	28,831	671.83	13,888	16,146	8,718
Silver Bow	120.84	2,498	36,893.53	762,657	10,400,840	5,616,454
Total	27,859.98	575,917	152,602.28	3,154,569	12,162,857	6,567,942

Mine production of gold, silver, copper, lead, and zinc in Montana in 1910, by counties.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaverhead	59,313	$7,533	273,985	$12,055			$104,583
Broadwater	124,938	15,867	245,935	10,821			360,243
Cascade	18,415	2,339	298,489	13,134			48,455
Chouteau, Flathead, and Lincoln	18,301	2,324	26,605	1,170			536,117
Deer Lodge	4,822	612					153,014
Fergus	1,167	148	60,254	2,651	18,000	972	645,536
Granite	18,867	2,396	26,321	1,158			250,545
Jefferson	122,109	15,508	1,975,492	86,922			792,111
Lewis and Clark	4,306	547	196,883	8,663			231,969
Madison	39,159	4,973	243,543	10,716			889,112
Meagher, Park, and Ravalli	15,789	2,006	195,819	8,616			17,462
Missoula and Sanders	36,738	4,666	164,752	7,249			59,281
Powell	79,767	10,130	48,041	2,114			63,681
Silver Bow	284,264,862	36,101,637	350,173	15,408	31,620,184	1,707,490	44,206 144
Total	284,808,553	36,170,686	4,106,292	180,677	31,638,184	1,708,462	48,358,253

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Tonnage of ore sold or treated, number of mines producing, and average value per ton of ores in Montana in 1909 and 1910, by counties.

County.	Ore sold or treated (short tons).		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	1910	Increase (+) or decrease (−).	1909	1910	1909	1910	1909	1910
Beaverhead	992	− 265	19	19	$56.72	$103.71	$33.59	$83.97
Broadwater	14,883	− 1,157	32	27	17.59	23.84	15.99	22.05
Cascade	1,381	− 575	9	12	30.06	35.08	27.66	23.88
Chouteau, Flathead, and Lincoln	56,656	− 22,005	7	8	8.98	9.43	8.98	9.37
Deer Lodge	5,604	− 1,450	13	14	28.34	26.94	27.99	26.83
Fergus	145,747	− 51,204	8	8	3.70	4.43	3.70	4.40
Granite	6,745	− 5,611	31	28	21.10	35.52	20.18	35.00
Jefferson	57,271	− 316	56	53	12.84	13.75	11.12	11.96
Lewis and Clark	45,510	+ 21,794	64	62	6.32	4.81	5.76	4.61
Madison	31,721	+ 10,099	105	82	14.75	13.29	14.23	12.79
Meagher, Park, and Ravalli	260	− 2,332	5	6	5.95	56.00	4.41	15.15
Missoula and Sanders	2,184	+ 1,993	5	7	35.88	10.56	8.60	5.11
Powell	1,063	− 77	23	14	31.43	32.70	21.00	21.18
Silver Bow	4,709,429	−290,633	71	83	9.46	9.38	1.26	1.35
Total	5,079,446	−341,739	448	423	9.39	9.41	1.79	1.91

[a] Value per ton, placer product excluded.

Tonnage of ores to gold and silver mills and concentrating mills, with gold and silver contained in bullion produced in Montana in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Beaverhead	3	1.64	1	.....
Broadwater	19	83.90	24	.....
Cascade	111	30.76	1,037	.....
Chouteau, Flathead, and Lincoln	56,515	24,425.94	44,533	92
Deer Lodge	591	316.94	250	.....
Fergus	145,367	29,983.31	7,414	.....
Granite	1,344	549.36	148	.....
Jefferson	84	42.87	20	30,800
Lewis and Clark	32,392	7,162.94	30,598	.....
Madison	28,380	5,727.29	46,038	9
Meagher, Park, and Ravalli	8	5.08	1	.....
Missoula and Sanders	1,217	166.42	27	510
Powell	260	135.01	12	5
Silver Bow	398	211.73	87	4,138,698
Total	266,689	68,843.19	130,190	4,170,114

Mine production of gold, silver, copper, lead, and zinc from Montana concentrates in 1910, by counties.

County.	Concentrates produced.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Broadwater	2	10.11	1	5	.....	.....	$210
Chouteau, Flathead, and Lincoln	54	45.02	877	118	21,330	.....	2,357
Jefferson	1,662	288.20	174,593	15,719	454,920	.....	122,252
Lewis and Clark	221	471.61	10,833	420	.....	.....	15,651
Madison	1,685	5,595.09	34,279	9,309	36,851	.....	136,975
Missoula and Sanders	106	5.01	5,419	69	62,586	.....	5,793
Powell	1	4.34	17	188	.....	.....	123
Silver Bow	1,277,588	25,170.00	7,982,625	222,077,842	132,668	31,334,204	34,732,698
Total	1,281,319	31,589.38	8,208,644	222,103,670	708,355	31,334,204	35,016,059

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Mine production of gold, silver, copper, lead, and zinc from Montana crude ore shipped to smelters in 1910, by counties.

County.	Crude ore to smelter.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaverhead	989	2,678.92	51,640	59,313	273,985	.....	$101,852
Broadwater	14,864	15,223.17	21,428	124,933	245,935	.....	352,948
Cascade	1,267	73.79	55,971	18,349	298,371	.....	47,208
Chouteau, Flathead, and Lincoln	49	6.07	471	18,183	5,275	.....	2,920
Deer Lodge	4,763	6,184.61	29,332	4,822	.....	.....	144,298
Fergus	380	819.57	1,869	1,167	60,254	18,000	21,721
Granite	5,221	2,817.78	308,132	18,867	26,321	.....	228,193
Jefferson	26,387	5,919.12	854,928	106,390	1,520,572	.....	664,437
Lewis and Clark	1,414	967.49	17,463	3,886	196,883	.....	38,586
Madison	3,332	5,352.44	32,960	29,850	206,692	.....	141,328
Meagher, Park, and Ravalli	252	69.95	4,419	15,789	195,819	.....	14,454
Missoula and Sanders	457	12.10	8,198	36,669	102,166	.....	13,829
Powell	798	532.48	15,953	79,579	48,041	.....	32,841
Silver Bow	556,423	11,385.08	2,363,611	57,456,675	217,505	285,980	8,833,733
Total	616,596	52,043.17	3,766,375	57,974,472	3,397,819	303,980	10,638,348

Number of producing mines, classified by chief products, in Montana in 1910, by counties.

County.	Placer mines.			Deep mines.												Total mines producing.
	Hydraulic.	Dredge.	Drift.	Gold.	Silver.	Copper.	Gold-silver.	Gold-copper.	Gold-silver-copper.	Gold-silver-copper-lead.	Gold-silver-lead.	Silver-copper-lead.	Silver-lead.	Silver-copper.	Silver-lead-zinc.	
Beaverhead	3	....	....	....	....	....	3	....	5	8	1	2	....	....	....	22
Broadwater	8	....	....	....	....	1	6	....	7	4	7	....	1	1	....	35
Cascade	.....	....	....	....	....	....	2	....	.....	3	3	1	3	....	....	12
Chouteau, Flathead, and Lincoln	2	....	....	1	....	....	2	....	.....	1	2	....	1	1	....	10
Deer Lodge	2	1	....	2	....	....	9	....	3	....	....	....	....	....	....	17
Fergus	.....	....	....	....	....	....	4	....	2	[a]1	....	....	1	....	....	8
Granite	6	....	1	....	....	....	9	....	10	4	5	....	....	....	....	35
Jefferson	13	....	....	....	....	....	14	1	8	13	13	2	2	....	....	66
Lewis and Clark	39	....	1	2	....	....	38	....	2	10	4	2	4	....	....	102
Madison	17	1	....	1	....	....	26	....	38	10	7	....	....	....	....	100
Meagher, Park, and Ravalli	4	....	1	....	....	....	2	....	.....	2	1	....	....	1	....	11
Missoula and Sanders	22	1	....	....	....	....	3	....	1	2	....	....	1	....	....	30
Powell	25	1	....	....	....	....	2	....	6	1	4	....	....	1	....	40
Silver Bow	5	1	1	....	....	7	28	....	[a]42	[a]5	1	....	....	2	....	90
Total	146	5	4	6	....	8	146	1	124	64	48	7	13	6	....	578

[a] One reported zinc.

PRODUCTION BY COUNTIES.

BEAVERHEAD COUNTY.

Mine production of gold, silver, copper, and lead in Beaverhead County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	584.47	$12,082	2,762.46	$57,105	+2,177.99	+$45,023
Silver.....do....	71,058	36,950	51,649	27,890	− 19,409	− 9,060
Copper.....pounds..	95,309	12,390	59,313	7,533	− 35,996	− 4,857
Lead.....do....	387,851	16,678	273,985	12,055	− 113,866	− 4,623
Total.....	.....	78,100	.....	104,583	.....	+ 26,483

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From 19 deep mines in 1910, 992 tons of ore were produced, 265 tons less than were reported from the same number of mines in 1909. The total value of the ore per ton increased from $56.72 in 1909 to $103.71 in 1910, and the gold and silver average value increased from $33.59 in 1909 to $83.97 in 1910. The ore mined contained $55,412 in gold, 51,641 ounces of silver, 59,313 pounds of copper, and 273,985 pounds of lead, with a total value of $102,886. In 1909 the ore produced was valued at $71,293. With the exception of 3 tons of ore treated at a milling plant in the county, the remainder, or 989 tons, was shipped directly to smelters. The placer gold and silver production aggregated $1,697 in value, as against an output valued at $6,807 in 1909.

Argenta district.—Nine deep-mine operators reported the shipment of 105 tons of ore to smelters, which yielded $1,977 in gold, 1,463 ounces of silver, 3,825 pounds of copper, and 25,128 pounds of lead, in all valued at $4,358, an average value of $41.50 per ton. The Gladstone, the Gold Finch, and the Hard Luck properties were operated, and small shipments of ore were made from other sources.

Bannock district.—Two deep mines and the same number of placers produced in 1910, the output being valued at $61,572. An increased tonnage of lead ore, having high values in gold, was produced from the old Golden Leaf mine by lessees. In 1909 the gold output from placers, with the ore shipped from the district, had a total value of $10,379. On the east fork of Dyers Creek are situated the Hard Luck placers, which were producers in 1910. The gold averages about 917 fine.

Bighole district.—A small test was made by the amalgamation process from one quartz claim in the district.

Blue Wing district.—Shipments of ore containing chloride of silver with lead carbonate and gray copper from one property and a small quantity of ore containing silver and copper aggregated 52 tons, valued at $7,793. In 1909 the ore shipments, 105 tons in quantity, were valued at $11,342. The Kent and the New Departure mines were producers.

Bryant district.—Shipping ore was produced by four operators in 1910 from the Atlantis and True Fissure, Cleopatra, Adrian, and Hecla properties. Through the neglect of one operator to report production, an estimate was made and included for an unorganized district. The district production of 1910 can not, therefore, be compared with that of 1909.

Polaris district.—The Dakota property produced ore containing largely silver and a little gold. It is developed by a tunnel 970 feet long.

Utopia district.—One deep mine, the Indian Queen, produced a small tonnage of copper ore carrying small values in gold and silver.

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BROADWATER COUNTY.

Mine production of gold, silver, copper, and lead in Broadwater County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	12,367.74	$255,664	15,574.58	$321,955	+3,206.84	+$66,291
Silver.....do....	12,216	6,352	21,480	11,600	+ 9,264	+ 5,248
Copper.....pounds..	180,693	23,490	124,938	15,867	− 55,755	− 7,623
Lead.....do....	50,941	2,190	245,935	10,821	+ 194,994	+ 8,631
Total.....	.....	287,696	.....	360,243	.....	+ 72,547

In 1910 there were 27 deep-mine operators reporting, 5 less than in 1909. The production of ore was 14,883 tons, representing a decrease of 1,157 tons from the output of 1909. The total average value per ton increased from $17.59 in 1909 to $23.84 in 1910, and the average gold and silver value of the ore from $15.99 to $22.05. The bulk of the ore, aggregating 14,864 tons, was shipped directly to smelters, yielding $314,691 in gold, 21,428 ounces of silver, 124,933 pounds of copper, and 245,935 pounds of lead, valued in all at $352,948, and averaging in value $23.75 per ton. In addition to the ore shipped to smelters, a small quantity was treated at small milling plants, yielding bullion and some concentrates. The output of the county in 1910 was classified and divided into 14,203 tons of dry or siliceous ores, the bulk of which was auriferous pyrite shipped from the Radersburg mines, 124 tons of copper ore and 556 tons of lead ore. The placer production of gold and silver, made by 8 operators in 1910, aggregated $5,336, as against an output valued at $5,553 in 1909.

Backer district.—The yield of ore and placer gold came from 2 deep mines and 2 placers. The district output consisted of $2,450 in gold, 31 ounces of silver, and 56,054 pounds of copper, with a total value of $9,585. Of the ore shipped, aggregating 107 tons, 104 tons were copper ore. One small lot was treated at an amalgamation mill, producing gold and silver bullion. The placer yield of the district aggregated $909. Ore from the Eclipse-Argo mine was shipped to smelters, and the Slim Jim property yielded gold and silver bullion from its ore treated by the amalgamation process. The ore found in this property is mined from rich pockets and seams reported to occur between granite and slate.

Beaver Creek district.—Eight deep mines and 1 placer yielded in 1910 an output valued at $28,315. The entire output of oxidized and sulphide ore was shipped to smelters and aggregated 534 tons, containing $15,346 in gold, 13,568 ounces of silver, 2,353 pounds of copper, and 120,322 pounds of lead, having a total value of $28,266. The placer gold reported was valued at $49. In 1909 the total district output by 10 deep mines and 2 placers was valued at $25,425.

Cedar Plains district.—The largest producers were the mines at Radersburg, the Keating, the Black Friday, and the Ohio. Other claims yielding production were the Horn, Gopher, Copper King, and Black Bug. In all, the tonnage aggregated 13,867 tons, containing

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$293,610 in gold, 4,793 ounces of silver, 65,009 pounds of copper, and 14,309 pounds of lead, having a total value of $305,084, and an average value per ton of $22. Included in this total were 8 tons of ore, which produced bullion and concentrate. The remainder of the ore was shipped directly to smelters. The bulk of the ore was auriferous iron pyrite and was shipped from the Keating mines to smelters, where it serves as a valuable fluxing material. During 1910 bismuth telluride was encountered, accompanying free gold associated with quartz, calcite, and chalcopyrite. Radersburg is the post office and is reached by 11 miles of good wagon road from Toston, a station on the Northern Pacific Railway. The district is described as follows by Bard.[1] For 40 years the gold camp of Radersburg has been the scene of more or less activity. The first mining was for placer gold, the production of which probably amounted to several hundred thousand dollars. Quartz mining began in the seventies on the oxidized ores, which were treated by amalgamation after crushing in small stamp mills and arrastres. This mining was intermittent and at no time very productive. Sulphide ores were usually encountered above a depth of 100 feet, and such ores were not milled. It was at Toston that W. Lawrence Austin made his first attempt at pyritic smelting; an attempt that fell a little short of commercial success. The Keating mine is the largest producer of ore. It has a vertical shaft 350 feet deep and an inclined shaft on the vein about completed to a depth of 600 feet. The property is now being equipped for a production of at least 100 tons of ore per day. The Black Friday mine is the next largest producer in the camp. It has an incline shaft 500 feet deep. The Ohio-Keating, Reno, Etta, and Mammoth properties are in the development stage. The Radersburg ores are found in narrow fissure veins in porphyritic rocks. The veins strike north-south usually and dip steeply to the west. They are little faulted. The unoxidized vein matter consists of auriferous pyrite in a gangue of calcite and quartz. Chalcopyrite, sphalerite, galena, marcasite, pyrrhotite, and chalcocite occur rarely. An extensive zone of igneous rocks breaking through Cretaceous shales, sandstones, and limestones occur here, trending north and south, and extending for at least 20 miles. These rocks consist of diorites, andesites, and some felsites and rhyolite. The mineralization occurs in these igneous rocks or is associated with them.

Lone Mountain district.—The Rena mine produced ore containing gold, silver, and copper. The post office of the district is Toston.

Park district.—The larger part of the entire ore production of the district, aggregating 299 tons, was shipped to smelters. In addition 8 tons were milled and produced gold bullion. The district ore output contained $5,412 in gold, 2,957 ounces of silver, 734 pounds of copper, 111,304 pounds of lead, in all valued at $11,999, with an average value of $39.08 per ton. There were 8 deep producing properties in 1910, including the Silver Wave, Park-New Era, Mammoth, Gold Hill Fraction, Silver Bell, and Giant Hill Fraction.

[1] D. C. Bard, Extract of paper read before Montana Society of Engineers at its Twenty-third Annual Meeting at Butte, Mont., June 8, 1910.

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CASCADE COUNTY.

Mine production of gold, silver, copper, and lead in Cascade County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	93.96	$1,942	104.97	$2,170	+ 11.01	+ $228
Silver.....do....	101,117	52,581	57,060	30,812	− 44,057	−21,769
Copper.....pounds..	540	70	18,415	2,339	+ 17,875	+ 2,269
Lead.....do....	109,589	4,712	298,489	13,134	+188,900	+ 8,422
Total.....	.....	59,305	.....	48,455	.....	−10,850

Twelve mine operators, nearly all of them in the Montana district, mined 1,381 tons of ore in 1910, which was 575 tons less than that mined by 9 operators in 1909. The total value of the ore per ton, however, increased from $30.06 in 1909 to $35.08 in 1910, but the average value of the gold and silver content in this ore decreased from $27.66 to $23.88. The bulk of the ore was of shipping grade and aggregated 1,267 tons, which contained $1,525 in gold, 55,971 ounces of silver, 18,349 pounds of copper, and 298,371 pounds of lead, with a total value of $47,208, and an average value of $37.26 per ton. At a cyanide mill 111 tons of ore were treated. The output of the county in 1910 is classified and divided into 774 tons of dry or siliceous ore, 579 tons of lead ore, and 28 tons of copper-lead ore. The principal mines producing shipping ore were the Barker group, the Ripple, the Broken Hill, Broadwater, Queen of the Hills, and Benton group.

CHOUTEAU COUNTY.

The total value of the output of Chouteau County, consisting of gold and silver only, was $528,643 in 1910, as against $704,135 in 1909. The principal mining operations were carried on at the August mine, near Landusky, and at the Mint mine of the Ruby Gulch Co., near Whitcomb. Both properties are equipped with cyanide mills, treating a porphyry ore. The August property began as a producer in 1909, and most of the ore mined in 1910 came from tunnel levels at a depth of 420 feet below the surface. A fire in the Ruby Gulch mill caused a decrease in the output of that property.

DEER LODGE COUNTY.

Reports from 14 deep mines in 1910, an increase of 1 over the number for 1909, showed a production of 5,604 tons of ore, 1,450 tons less than was mined in 1909. The total average value of the ore decreased from $28.34 in 1909 to $26.94 in 1910, and the gold and silver average value per ton showed a corresponding decrease from $27.99 to $26.83. The ore mined and shipped contained $127,847 in gold, 29,332 ounces of silver, and 4,822 pounds of copper, with a total average value of $30.29 per ton. No lead was reported in 1910. In 1909 the ore produced was valued at $199,886. In addition to the ore shipped, 591 tons were treated at milling plants, yielding bullion containing $6,552

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in gold and 250 ounces of silver. The placer production aggregated $2,029, as against an output valued at $1,498 in 1909.

Georgetown district.—In 1910 13 operators reported production of ore aggregating 5,602 tons, which included some old tailing. The district output contained $134,216 in gold, 29,578 ounces of silver, and 4,818 pounds of copper, with a total value of $150,799 and an average value of $26.92 per ton. In 1909 the value of 6,390 tons of ore, representing the output of the district, averaged $30.19 per ton. The principal producers in 1910 were the Oro Fino, Southern Cross, George, Hidden Treasure, and Holdfast mines.

Heber district.—Two placer operators reported a production in 1910 of $1,593 in gold and 5 ounces of silver. The French Gulch placer, one of the principal properties, is situated 20 miles south of Anaconda. It is worked with an Evans hydraulic elevator. The fineness of the gold produced averages about 893.

Race Track district.—Only 1 deep-mine operator reported production of ore, which contained principally gold, with a little silver and copper.

FERGUS COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Fergus County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	35,121.89	$726,034	30,802.88	$636,752	−4,319.01	−$89,282
Silver.....do....	5,491	2,855	9,283	5,013	+ 3,792	+ 2,158
Copper.....pounds..	204	26	1,167	148	+ 963	+ 122
Lead.....do....	11,210	482	60,254	2,651	+ 49,044	+ 2,169
Zinc.....do....	.....	.....	18,000	972	+ 18,000	+ 972
Total.....	.....	729,397	.....	645,536	.....	− 83,861

Eight operators of deep mines reported production in 1910, the same number as in 1908 and 1909. The ore treated aggregated 145,747 tons, which was 51,204 tons less than in 1909. The gold and silver values predominated, and the small quantities of copper, lead, and zinc did not particularly affect the average values. The total average value increased from $3.70 per ton in 1909 to $4.43 in 1910. Mills equipped with the cyanide process treated nearly all the ore produced in the county, except the higher-grade ore containing base metals, which was shipped directly to the smelters. This aggregated 380 tons, yielding $16,942 in gold, 1,869 ounces of silver, 1,167 pounds of copper, 60,254 pounds of lead, and 18,000 pounds of zinc, having a total value of $21,721 and an average value of $57.16 per ton.

North Moccasin district.—The output of the district, which is chiefly gold and silver, decreased in 1910 to $412,889 in gold and 3,645 ounces of silver from a production in 1909 of $620,846 in gold and 3,790 ounces of silver. This decrease was caused by the shutdown of the mills of the Kendall and Barnes-King mines for a short period of time, during which a new management took hold of the latter. The North Moccasin mine was reported idle.

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Warm Springs district.—Six mine operators reported a production of 47,614 tons of ore, which contained $223,863 in gold, 5,638 ounces of silver, 1,167 pounds of copper, 60,254 pounds of lead, and 18,000 pounds of zinc, having a total value of $230,679 and an average value of $4.84 per ton. This total includes the first recorded sale in the district of zinc ore containing payable quantities of lead, silver, and gold produced from the War Eagle property. The principal production of gold and silver was from ores milled from the Gold Reef mines. Important productions of oxidized and sulphide ores came, respectively, from the Cumberland and the Maginnis mines. A small quantity of lead-silver ore was produced by a lessee from the Cave claim.

FLATHEAD COUNTY.

In the eastern part of the county from near Essex a small shipment of copper sulphide ore containing silver was shipped from the Great Northern mine. The property is developed by a tunnel 800 feet long. Forest fires in 1909 destroyed a milling plant connected with the mine.

GRANITE COUNTY.

Mine production of gold, silver, copper, and lead in Granite County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	3,780.17	$78,143	3,891.43	$80,443	+111.26	+$2,300
Silver.....do....	356,485	185,372	308,423	166,548	−48,062	−18,824
Copper.....pounds..	62,251	8,093	18,867	2,396	−43,384	− 5,697
Lead.....do....	76,189	3,276	26,321	1,158	−49,868	− 2,118
Total.....	.....	274,884	.....	250,545	.....	−24,339

Ore was produced in the county by 28 mine operators in 1910 and amounted to 6,745 tons, which was 5,611 tons less than was mined by 31 operators in 1909. The total average value of the ore per ton increased from $21.10 in 1909 to $35.52 in 1910, and the gold and silver average value per ton increased from $20.18 to $35. The largest part of the ore was shipped to smelters and aggregated 5,221 tons, which contained $58,249 in gold, 308,132 ounces of silver, 18,867 pounds of copper, and 26,321 pounds of lead, with a total value of $228,193 and an average value of $43.71 per ton. The remainder of the ore, aggregating 1,344 tons, produced bullion containing $11,356 in gold and 148 ounces of silver, with a total value of $11,436 and an average value of $8.51 per ton. No concentrate was reported. The output of gold and silver from placer operations aggregated $10,915, against a production in 1909 of $14,142 and in 1908 of $12,859.

First Chance or Garnet district.—Reports were received from 7 deep mines, and the placer output was reported by a merchant. The ore yield aggregated 781 tons, containing $44,154 in gold, 2,340 ounces of silver, and 2,929 pounds of copper, in all valued at $45,790. All of the ore was shipped directly to the smelters. The placer output was $527 in gold and 2 ounces of silver. In 1909 the output was $2,252

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in gold and 13 ounces of silver. The principal deep-mine production came from the Magone & Anderson property, yielding gold and silver oxidized and sulphide ore, with a little copper. The oxidized ores are reported found to a depth of 900 feet on the dip of the vein. The Shamrock, the Nancy Hanks, the International, and the Grant & Hartford mines were also producers. Nearly all of the properties were operated by lessees.

Flint Creek district.—The output of 14 deep mines in 1910 aggregated 4,396 tons of ore, containing $11,341 in gold, 305,728 ounces of silver, 15,894 pounds of copper, and 26,321 pounds of lead, valued in all at $179,610, with an average value of $40.86 per ton. All of the ore produced was of shipping grade, with the exception of 2 tons, which was treated at a milling plant and produced gold bullion. The mill of the Hope mine was idle and all the ore mined was shipped directly to smelters. The Granite-Bimetallic was the principal producer of ore, and others with important yield were the Hobo group, the Pearl, the Little Bee, and the Good Luck.

Red Lion district.—The production made by 3 deep mines in 1910 aggregated 411 tons. The larger part of the output, or 382 tons, consisting of oxidized ore, was treated at two mills, recovering gold and silver bullion by amalgamation and cyanidation. The remainder, 29 tons, was shipped directly to the smelter. The total product aggregated in value $5,185. The producers were the American Flag, the Red Lion, and the Hidden Lake mines.

South Boulder district.—The yield made by 3 deep mine operators aggregated 460 tons of milling ore, producing gold and silver bullion, and 17 tons of ore, containing gold and silver, shipped directly to the smelter. The placer output was the most important and was $9,262 in gold and 136 ounces of silver, against a placer output reported in 1909 of $11,246 in gold and 167 ounces of silver.

JEFFERSON COUNTY.

Mine production of gold, silver, copper, and lead in Jefferson County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	5,342.54	$110,440	6,468.17	$133,709	+1,125.63	+$23,269
Silver.....do....	1,031,146	536,196	1,029,579	555,972	− 1,567	+ 19,776
Copper.....pounds..	241,655	31,415	122,109	15,508	− 119,546	− 15,907
Lead.....do....	1,568,696	67,454	1,975,492	86,922	+ 406,796	+ 19,468
Total.....	.....	745,505	.....	792,111	.....	+ 46,606

Reports from 53 deep mines in 1910, against 56 in 1909, gave a yield of 57,271 tons of ore, 316 tons less than in 1909. The total value of this ore per ton increased from $12.84 in 1909 to $13.75 in 1910, and the average value of the gold and silver content increased from $11.12 in 1909 to $11.96 in 1910. The bulk of the ore, aggregating 30,800 tons, was treated at concentration mills and yielded 1,662 tons of concentrate, which contained $5,958 in gold, 174,593 ounces of silver, 15,719 pounds of copper, and 454,920 pounds of lead,

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having a total value of $122,252 and an average value of $73.56 per ton. There was very little change in the quantity of ore treated at concentration mills and its content and total value in 1910 as compared with the output treated in 1909. Smelters received 24,514 tons in 1909, as against 26,387 tons in 1910, and the content, which corresponds very closely to the production of 1909, yielded $122,359 in gold, 854,928 ounces of silver, 106,309 pounds of copper, and 1,520,572 pounds of lead, having a total value of $664,437 and an average value of $25.18 per ton. The bullion output from milling plants was very small. The placer production was valued at $4,526 in 1910, as against $5,966 in 1909 and $1,617 in 1908.

Amazon district.—The tonnage of ore reported by 2 operators aggregated 56 tons, which contained $204 in gold, 553 ounces of silver, 951 pounds of copper, and 8,456 pounds of lead, valued at $996, an average value of $17.78 per ton. In 1909 the average value of 74 tons of ore was $26.59 per ton. The producers were the Silver Star and the Emma May properties.

Boulder district.—Production of ore made by 2 deep mines aggregated 165 tons, which contained $1,163 in gold, 2,949 ounces of silver, 1,935 pounds of copper, and 25,483 pounds of lead, valued in all at $4,122, an average value of $24.98 per ton. This ore was shipped directly to the smelters. The placers operated by 3 producers yielded $619 in gold and 8 ounces of silver.

Cataract district.—The total ore produced in 1910 aggregated 1,719 tons, containing $53,928 in gold, 44,112 ounces of silver, 5,272 pounds of copper, and 55,093 pounds of lead, valued in all at $80,841, an average value of $47.03 per ton. All of this ore, with the exception of 20 tons, which produced gold and silver bullion, was shipped to smelters. The placer output amounted to $686 in gold and 8 ounces of silver. In 1909 the yield from placers was $602 in gold and 6 ounces of silver. Among the principal deep mines producing were the Ruby, the Gray Eagle, the Comet, and the Minneapolis. Most of the production from smaller properties was made by lessees.

Colorado district.—Deep mine operators reporting in 1910 produced 1,401 tons of ore from 9 properties. This ore contained $6,482 in gold, 26,537 ounces of silver, 47,304 pounds of copper, and 172,684 pounds of lead, valued in all at $34,418, and averaging $24.56 per ton. All but 64 tons, which produced gold and silver bullion at a milling plant, was shipped to smelters. The placer production reported by 2 operators aggregated $393 in gold and 4 ounces of silver. In 1909 the placer output was $306 in gold and 9 ounces of silver.

Elkhorn district.—Reports were received from 7 deep mines, aggregating a yield of 53,429 tons of ore, which contained $59,059 in gold, 950,519 ounces of silver, 64,145 pounds of copper, and 1,642,105 pounds of lead, with a total value of $652,738, and an average value of $12.22 per ton. This was an increase in production over that made in 1909, which was 52,082 tons, with a total value of $584,119. About half the ore produced was milled at the plant connected with the Elkhorn mine, yielding concentrate, which contained gold, silver, lead, and a small amount of copper. The remainder of the ore produced was shipped directly to the smelters.

Lump Gulch district.—Six deep mines produced 120 tons of ore, containing $1,514 in gold, 3,413 ounces of silver, 2,220 pounds of copper, and 21,600 pounds of lead, valued in all at $4,590, and having

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an average value of $38.25 per ton. All of this ore was shipped directly to smelters. The producers were the B. & G., the Good Cheer, the Queen of May, the Little Nell, the Eagle's Nest, and the Rachael claims.

Mitchell district.—The shipment to smelters of 161 tons of ore by 2 deep mine operators contained gold, silver, and a little copper. Two producing placers brought the total value of the output of the district to $6,109 in 1910.

Whitehall district.—All of the ore produced in 1910 by 3 operators, aggregating 166 tons, was shipped directly to the smelters, and contained $1,842 in gold, 855 ounces of silver, and 50,071 pounds of lead, with a total value of $4,507. The placer production was $195 in gold and 1 ounce of silver.

LEWIS AND CLARK COUNTY.

Mine production of gold, silver, copper, and lead in Lewis and Clark County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.....fine ounces..	821.74	$16,987	632.89	$13,083	− 188.85	− $3,904
Silver.....do....	185	96	99	53	− 86	− 43
DEEP MINES.						
Gold.....fine ounces..	5,759.62	119,062	8,602.04	177,820	+2,842.42	+58,758
Silver.....do....	33,566	17,455	58,894	31,803	+ 25,328	+14,348
Copper.....pounds..	5,798	754	4,306	547	− 1,492	− 207
Lead.....do....	293,285	12,611	196,883	8,663	− 96,402	− 3,948
Total.....	.....	166,965	.....	231,969	.....	+65,004

Ore and old tailings were treated and reported by 62 operators in 1910, against 64 in 1909. The total tonnage treated aggregated 45,510 tons, which was 21,794 tons greater than in 1909. The total average value per ton of the material treated decreased from $6.32 in 1909 to $4.81 in 1910, and the average value of the gold and silver content decreased from $5.76 to $4.61 per ton. The bulk of the ore treated at mills was siliceous in character, aggregating 32,392 tons, which produced some concentrate and bullion containing $148,071 in gold and 30,598 ounces of silver. Old tailings, estimated at 11,704 tons, yielded additional gold and silver bullion. The ore shipped directly to smelters aggregated 1,414 tons, which contained $19,999 in gold, 17,463 ounces of silver, 3,886 pounds of copper, and 196,883 pounds of lead, having a total value of $38,586 and an average value of $27.29 per ton. Forty placer operators reported in 1910, as against 37 in 1909. The output from this source aggregated $13,083 in gold and 99 ounces of silver, against $16,987 in gold and 185 ounces of silver in 1909.

Bald Butte district.—Included in the production of this district is an estimate for a large tonnage of old tailings re-treated by lessees using the cyanide process. The Strawberry mine was the principal producer of gold-silver ore, which was treated at its milling plant,

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and a small lot of ore was shipped to the smelter from the Bald Butte property. The total output of the district aggregated $4,646 in value in 1910.

Dry Gulch district.—Lead ore was shipped from the district by 1 deep mine operator. In addition to this production, the placer output aggregated $5,477 in gold and 38 ounces of silver. In 1909 the placer output was $5,442 in gold and 38 ounces of silver.

Gould district.—Two deep mines were operated during the year and the production reported aggregated $37,565 in gold and 2,667 ounces of silver.

Grass Valley district.—Only 1 deep mine operator reported production of ore, containing gold and silver, in 1910.

Greenhorn district.—The Bessie mine produced lead ore, containing gold and silver, which, with the placer output of 2 operators, was valued at $1,095.

Helena district.—Eleven deep mines and 12 placers yielded $9,891 in gold and 385 ounces of silver in 1910, as against an output valued at $13,525 in 1909. The larger part of the ore produced was shipped directly to the smelters and the remainder was treated at a small amalgamation mill on the Old Dominion & Arrowhead property. A quantity of ore was shipped from the McIntyre property.

Lincoln district.—The placer yield reported by 6 operators aggregated $1,485 in gold and 7 ounces of silver, as against a production of $1,551 in gold and 6 ounces of silver in 1909.

Ottawa district.—In 1910 ore and old tailings re-treated aggregating 34,683 tons were reported by 30 deep mine operators. Of the total output, 27,243 tons, yielding gold and silver bullion and some concentrates, were treated at milling plants, and 186 tons of crude ore, containing lead and a little copper, were shipped directly to smelters. It is estimated that 7,254 tons of old tailings were treated. The gold and silver produced is included in the district total of $116,305 in gold, 41,445 ounces of silver, 2,392 pounds of copper, and 30,128 pounds of lead. With a placer production of $102 in gold, the total yield of the district was valued at $140,417, which is over double the total value of $65,885 in 1909. The principal deep mine producers were the Bald Mountain, the Drumlummon, the Towsley & Nile, and the Honey-comb properties. A large number of lessees of deep mines reported production. The Canyon Creek tailings continue to be a source of profit to several operators of cyanide plants.

Poorman district.—Three placer operators in 1910 produced $740 in gold and 5 ounces of silver, against a production of $340 in gold and silver in 1909.

Stemple district.—The Klondyke, a lode claim, and 4 placers yielded gold and silver valued at $1,202.

Springhill and Unionville districts.—The output of 3 deep mines and 2 placers, valued in 1910 at $5,417, was a decrease from the output of 1909, which was valued at $35,480, mainly in gold. This decrease was caused by the decreased operations of several important properties and the idleness of the Spring Hill mine.

Vaughn district.—In 1910 the district was credited with a production of 762 tons of ore from deep mines, yielding $5,934 in gold, 11,670 ounces of silver, 927 pounds of copper, and 120,419 pounds of lead, in all valued at $17,652, an average value per ton of $23.17. All but 3 tons of ore, which were treated by amalgamation, was

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shipped directly to smelters. The placer output was $758 in gold and 7 ounces of silver. In 1909 the total value of the deep mine and placer output of the district was $23,940, of which $4,135 in gold and 96 ounces of silver was credited to placers.

LINCOLN COUNTY.

Libby and Sylvanite districts.—The output of gold, silver, copper, and lead from 5 deep mines, with the placer bullion from 2 sources, aggregated $5,048 in value in 1910, as against an output valued at $2,377 in 1909. At 2 mills in these districts ore was treated, yielding gold bullion and concentrate, while 23 tons of crude ore with concentrate were shipped directly to the smelter. The ore mined was classified as 192 tons of siliceous ore, containing 100.09 ounces of gold and 16 ounces of silver; and 16 tons of lead ore, containing 1.98 ounces of gold, 110 ounces of silver, and 2,619 pounds of lead. Placer operators reported a production valued at $1,863. The Snowshoe was developed during a short period, and sulphide ore from former operations was shipped. Test shipments were made from three other properties in the Libby district. Near Sylvanite, the Keystone and the Gold Flint groups were equipped with a 30-stamp mill, which was operated until August, when the forest fires destroyed both this plant and the surface equipment of many other properties. A new mill was under construction before the close of the year.

MADISON COUNTY.

Mine production of gold, silver, copper, and lead in Madison County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.....fine ounces..	20,700.97	$427,927	22,553.49	$466,222	+1,852.52	+$38,295
Silver.....do....	3,328	1,731	2,468	1,333	− 860	− 398
DEEP MINES.						
Gold.....fine ounces..	12,658.04	261,665	16,674.82	344,699	+4,016.78	+ 83,034
Silver.....do....	88,530	46,035	113,277	61,169	+ 24,747	+ 15,134
Copper.....pounds..	22,491	2,924	39,159	4,973	+ 16,668	+ 2,049
Lead.....do....	191,045	8,215	243,543	10,716	+ 52,498	+ 2,501
Total.....	.....	748,497	.....	889,112	.....	+140,615

One hundred mine operators reported production in 1910. Eighteen worked placers and 82 worked deep mines, as against 15 placer and 105 deep-mine operators in 1909. The total output of gold in 1910 from placer and deep mines amounted to $810,921, which exceeds the gold output of any other county in the State, the placer gold being a little over half the amount, or $466,222. The output of ore, aggregating 31,721 tons, is 10,099 tons greater than in 1909. The total average value per ton decreased from $14.75 in 1909 to $13.29 in 1910, with a corresponding decrease in the gold and silver average value from $14.23 to $12.79 per ton. The ore output was

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divided into 31,230 tons of dry or siliceous ore, 34 tons of copper ore, and 457 tons of lead ore. The greater part of the tonnage of ore was treated at milling plants, where 28,380 tons yielded bullion containing $118,394 in gold and 46,038 ounces of silver. An increased quantity of concentrate, over double the quantity produced in 1909, was shipped in 1910, and aggregated 1,685 tons, containing $115,661 in gold, 34,279 ounces of silver, 9,309 pounds of copper, and 36,851 pounds of lead, in all valued at $136,975 and averaging $81.29 per ton. Smelters received 3,332 tons, yielding $110,645 in gold, 32,960 ounces of silver, 29,850 pounds of copper, and 206,692 pounds of lead, valued at $141,328, with an average value of $42.42 per ton. The production from placers in 1910 was $466,222 in gold and 2,468 ounces of silver. The placer output in 1909 aggregated $427,927 in gold and 3,328 ounces of silver; in 1908 it was $414,939 in gold and 3,238 ounces of silver.

Alder Gulch district.—Compared with the production of placers, the output of deep mines in this district was insignificant in 1910 and was valued at $15,587. The output of 379 tons of ore contained $8,424 in gold, 11,648 ounces of silver, 1,847 pounds of copper, and 14,533 pounds of lead. All of this ore was shipped to smelters and averaged in value $41.12 per ton. The principal deep-mine producers were the U. S. Grant, the High Tariff, the Belmont, the Prospect, and the High Ridge. In 1909 the ore mined aggregated 445 tons and the larger part, or 309 tons, was shipped to smelters. Three dredges and four placer properties worked by hydraulicking and sluicing produced the largest part of the county output of gold and silver in 1910. The Conrey placers were recently equipped with the fourth dredge, which was reported in operation late in December. It is said to be the largest gold dredging machine in the world and treats 8,000 yards of gravel per day. The dredge is provided with 86 buckets, each lifting 16 cubic feet of gravel. Each bucket weighs 4,200 pounds and will dig 55 feet below the water line. All of the dredges are operated by electricity. The dredge company now operates placer ground reported to carry about 17 cents in gold per cubic yard, and with the new dredge it is said the cost of operation will not exceed 5 cents a cubic yard. The placer ground operated by the dredges extends from about 5 miles above Ruby, in Alder Gulch proper, to 2 miles below Ruby, mostly in the Ruby River Valley, making in all about 7 miles of workable property.

Lower Hot Springs district.—From the operations of 8 deep mines, 183 tons of ore were produced, 153 tons of which were shipped directly to the smelters, and the remainder of which was treated at an amalgamation mill. The ore produced in the district contained $2,871 in gold, 1,172 ounces of silver, 33 pounds of copper, and 4,485 pounds of lead, valued at $3,705, with an average value of $20.24 per ton. In 1909 the average value of 136 tons of shipping ore was $22.02 per ton. The principal producers were the Gleason, the Red Rose, the Hecla, and the Potomac.

Mineral Hill district.—In 1910 the total value of 15,301 tons of ore, produced by 10 operators, aggregated $142,098. This ore contained $135,880 in gold, 6,651 ounces of silver, and 20,671 pounds of copper. The average value was $9.29 per ton. Of the total ore produced, 401 tons were shipped directly to smelters and 14,900 tons were treated at two milling plants, producing gold bullion and con-

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centrates. In 1909 the tonnage of ore produced by 15 operators aggregated 7,474 tons and averaged in value $12.30 per ton. The Iron Chief and the Atlanta mines produced ore treated at milling plants, and shipments to smelters direct were made from the Ben Harrison, Old Joe, Oregon, Pony, Union, Mountain Cliff, and Strawberry mines. The Boss Tweed-Clipper mines were the principal producers of gold and silver bullion, concentrate, and ore of shipping grade. Sulphide ore with a siliceous gangue was treated in 1910. The sulphide iron ore was mined from the Boss Tweed property and the oxidized ores from the Clipper mine. A 15-stamp mill, equipped for amalgamation and concentration, was kept in operation throughout the year. The lower part (below the 700 foot level) of the properties is being worked. Shipments of gold bullion, concentrate, and crude ore were made from the Strawberry property. The ore mined is similar to that from the Boss Tweed property. A 10-stamp mill, with which the mine is equipped, was operated part of 1910.

Norwegian district.—Four deep-mine operators in 1910, against two operating in 1909, were credited with a production of 90 tons of ore, of which 81 tons were shipped directly to smelters and the remainder was concentrated at a milling plant. The total production was valued at $1,829 in gold, silver, and copper, an average value of $20.32 per ton. In 1909 the total average value of 101 tons of ore was $25.45.

Ramshorn district.—The output of the district, valued at $2,886, was produced from 1 deep mine and 8 placers in 1910. With the exception of $2,315 in gold and 24 ounces of silver from placers, the output was the yield of 19 tons of gold and silver ore from the Ellijay property.

Rabbit district.—Six deep mines produced 260 tons of ore, containing gold, silver, and lead, with a little copper. All of this product was shipped directly to the smelters. The producers were the Traufler, Germania, Blue Bird-New, Combination, and other properties. The placers yielded $159 in gold and 1 ounce of silver.

Sheridan district.—This district was credited with a production valued at $15,462 from 6 deep mines, 511 tons of ore, which contained $13,717 in gold, 2,390 ounces of silver, 3,491 pounds of copper, and 243 pounds of lead. Of the total output 300 tons were treated at two milling plants, producing bullion and concentrate, and 211 tons of ore were shipped directly to the smelter. The Gladstone, Noble, and Belle mines yielded the principal quantities of ore.

Silver Star district.—Fourteen mine operators reported the production of 601 tons of ore, containing $22,989 in gold, 1,211 ounces of silver, 6,261 pounds of copper, and 4,298 pounds of lead, valued at $24,626, with an average value of $40.97 per ton. The bulk of the ore was shipped directly to the smelters, and 12 tons treated at an amalgamation mill yielded gold and silver bullion. In 1909 the total output of 990 tons of ore yielded an average value of $35.13 per ton. Among the producers in 1910 were the Greene-Campbell, Hudson, Keystone, Broadway, Stella, and Moonlight mines.

Summit district.—Reports were received from 9 deep mine operators producing 12,262 tons of ore. The largest part of the output, 11,318 tons, was treated at two milling plants, yielding gold and silver bullion and concentrates. The remainder of the ore, 944 tons in quantity, was shipped directly to smelters. The total value of the

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district production in 1910 was $181,949, as against a total value of $96,232 in 1909. The placer production of $5,205 in gold and 36 ounces of silver is included in the total value. The largest production was made by the Easton-Pacific mine, and others with minor productions were the Apex, the Winnetka, the Mapleton, and the Elfleda.

Tidal Wave district.—Eight deep mine operators reported a production of 677 tons of ore, 470 tons of which were treated at milling plants equipped for concentration and amalgamation, and the remainder, 207 tons, was shipped directly to smelters. The total yield of these ores was $15,423 in gold, 7,459 ounces of silver, 2,307 pounds of copper, and 118,551 pounds of lead, valued in all at $24,960, with an average value of $36.87 per ton. The producers were the Carolina, Ella, Keyhole, Little Goldie, Moonlight, Topeka, Van Meter, and Aparanda mines.

Upper Hot Springs district.—The production of 1,150 tons of ore by 5 deep mine operators yielded $5,798 in gold, 238 ounces of silver, 94 pounds of copper, and 221 pounds of lead, in all valued at $5,948, an average value of $5.17 per ton. All of this ore, with the exception of 50 tons which were shipped to the smelter, was treated in an amalgamation mill, producing bullion. The principal producers were the Monitor-Revenue, Galena-Boaz, and New York Belle mines.

Washington Gulch district.—The Lehigh property produced milling ore which yielded gold and silver bullion, and some crude ore was shipped directly to the smelters. The Black Hawk 10-stamp mill was operated during 1910.

MEAGHER COUNTY.

Two deep mine operators and 1 placer operator reported in 1910, the product having an aggregate value of $1,729. The ore shipped, 43 tons in quantity, contained 12 ounces of silver and 12,730 pounds of copper, having a total value of $1,623 and an average value of $37.74 per ton. All of the ore and placer gold produced was the output of Musselshell district.

MISSOULA COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Missoula County, Mont., in 1909 and 1910.

Metal.	1909.		1910.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.....fine ounces..	1,223.06	$25,283	1,749.34	$36,162	+526.28	+$10,879
Silver.....do....	49	25	78	42	+ 29	+ 17
DEEP MINES.						
Gold.....fine ounces..	33.77	698	137.82	2,849	+104.05	+ 2,151
Silver.....do....	1,392	724	8,003	4,322	+ 6,611	+ 3,598
Copper.....pounds..	784	102	.....	.....	− 784	− 102
Lead.....do....	31,392	1,350	92,523	4,071	+61,131	+ 2,721
Zinc.....do....	60,570	3,271	.....	.....	−60,570	− 3,271
Total.....	.....	31,453	.....	47,446	.....	+ 15,993

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Twenty-six operators reported production in 1910, 23 of which operated placers and the remaining 3 deep mines. The ore produced aggregated 1,718 tons, containing $2,849 in gold, 8,003 ounces of silver, and 92,523 pounds of lead, valued at $11,242, with an average value of $6.54 per ton. The bulk of the ore, 1,165 tons, was treated at three milling plants, producing bullion and concentrate. The remainder, 43 tons, was shipped directly to the smelters. The total output of ore was divided into 1,165 tons of dry or siliceous ore and 553 tons of lead ore. The placer output, valued at $25,308 in 1909, increased to $36,204 in 1910.

Cedar, Quartz, and Trout creeks.—For convenience in tabulation, the output of placers situated in the California, Sunrise, Hungry Hollow, and Tucker gulches and the Oregon, Windfall, and McCornick creeks is included in this paragraph. From 19 placers and 1 deep mine was reported an aggregate production of $34,493 in gold and 92 ounces of silver. Part of the gold was produced as bullion from an amalgamation mill. The principal placers operated were those on Cedar Creek, worked with a large dredge; and those worked by hydraulic and sluicing methods were the Blue Bird, Wolfe, Deep Gulch, Whipsaw, Meadow Creek, Oregon Gulch, Stockholm, and Windfall. The placer gold ranges in fineness from 902 to 982.

Iron Mountain district.—As a result of considerable development work in 1909, the Iron Mountain mines produced silver-lead sulphide ore, and the 300-ton concentration plant was operated on ore yielding a lead-silver-zinc concentrate in 1910. Sulphide ores extend from the surface of the property to a depth of 1,850 feet. The tunnel, which has been driven 5,700 feet, allows the mine to be operated economically. The mine is credited with a total output valued at $2,000,000.

Ninemile district.—The production reported from 4 placers and 1 deep mine aggregated $4,521 in value, against that made by 5 placers yielding bullion valued at $7,550 in gold and 6 ounces of silver in 1909. The gold nuggets produced in this district are much in demand, and it is possible that considerable placer gold escapes the inquiry of the statistician, as it is sold to jewelers and tourists. As a rule, however, producers include the figures for such gold in the reports to the Survey. The Ninemile mine produced gold ore, which was treated at an amalgamation plant. The placers actively developing and producing were the Chrysalis, the Tom Tom, and the Slide. Placer gold in this district averages in fineness about 982.

PARK COUNTY.

Placers in Emigrant Gulch, near Chico, were worked by hydraulic and sluicing methods by small operators in 1910. In the New World district mining property was operated on the south slope of Miller Mountain, producing lead ore containing gold and silver that was treated at the local smelter, which operated 30 days in 1910.

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POWELL COUNTY.

Mine production of gold, silver, copper, and lead in Powell County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.....fine ounces..	1,365.19	$28,221	1,394.70	$28,831	+ 29.51	+ $610
Silver.....do....	171	89	164	88	− 7	− 1
DEEP MINES.						
Gold.....fine ounces..	825.81	17,071	671.83	13,888	−153.98	−3,183
Silver.....do....	13,221	6,875	15,982	8,630	+ 2,761	+1,755
Copper.....pounds..	81,791	10,633	79,767	10,130	− 2,024	− 503
Lead.....do....	29,159	1,254	48,041	2,114	+18,882	+ 860
Total.....	.....	64,143	.....	63,681	.....	− 462

The production of ore reported by 14 mine operators in 1910 aggregated 1,063 tons, which is 77 tons less than that reported by 23 operators in 1909. The total average value per ton increased from $31.43 in 1909 to $32.70 in 1910, and the total average value per ton of gold and silver in this ore increased from $21 to $21.18. The total output was divided in 1910 into 330 tons of dry or siliceous ore, 215 tons of copper ore, 101 tons of lead ore, and 417 tons of copper-lead ore. Shipments to the smelters consisted of 798 tons and yielded $11,008 in gold, 15,953 ounces of silver, and 79,579 pounds of copper and 48,041 pounds of lead, the total valued at $31,841, an average value of $39.90 per ton. The remainder of the ore, consisting of 260 tons, yielded bullion and concentrate. There were 26 placer operators reporting a total yield of $28,831 in gold and 164 ounces of silver, as against a production in 1909 of $28,221 in gold and 171 ounces of silver.

Big Blackfoot district.—The total output was reported for this district in 1910 by 1 deep mine and 3 placer operators and aggregated $3,418 in gold and 17 ounces of silver. In 1909 the output was made by 2 deep mines and 3 placers and was valued at $1,529 in gold and 56 ounces of silver. The Trapper claim, the Carmen, and two other placers were producers.

Coloma district.—Two deep mines in 1910, the same number producing in 1909, were reported as producers of gold, silver, and a little copper. Part of the shipments consisted of concentrate from previous work on the Comet property.

Deadwood Gulch district.—Only 1 placer operator reported production from this district in 1910.

Ontario district.—Two deep-mine operators reported production of ore containing gold, silver, copper, and lead in 1910. No placers were reported to have produced. The total output of the district, valued at $553, was shipped directly to smelters. This was a marked decrease from the production of 1909, when the yield had a total value for the same metals of $10,580.

Ophir district.—Five deep mines and 10 placers in 1910 yielded $11,426 in gold, 10,793 ounces of silver, 67,561 pounds of copper, and

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31,556 pounds of lead, the total valued at $27,221. The entire deep-mine product was shipped directly to smelters and consisted of 621 tons of ore. The total includes the placer product of $2,592 in gold and 18 ounces of silver. In 1909 the total product was valued at $20,925, and included the placer product of gold valued at $3,221 and 16 ounces of silver. The Julia, Flagstaff, Ajax, Rawlings, and Fairview were reported as deep-mine producers. The principal placers producing were the Comet Bar, Tomera, Ward, and Warm Springs Hill. The gold from placers averaged from 849 to 911 in fineness.

Pioneer district.—Production of 7 placer operators in 1910 aggregated $22,493 in gold and 128 ounces of silver. This is an increase from $21,883 in gold and a decrease from 197 ounces of silver made by 1 deep mine and 7 placers in 1909. The placers operated were the Gold Creek, Pioneer, Pure Gold, and Upper Gold Creek. Placer gold in this district averages from 850 to 895 in fineness and is recovered from the gravels largely by hydraulic and sluicing methods.

Washington Gulch district.—Four placer operators produced $2,827 in gold and 12 ounces of silver, as against a production made by 1 deep mine and 7 placers in 1909 of $4,211 in gold and 9 ounces of silver. The placers producing were the Ruther, the Scotch Bar, and that operated by the Walking Dredge Co.

Zozell district.—Operators of 3 deep mines in 1910, the same number reporting in 1909, yielded oxidized and sulphide ores containing gold, silver, and lead. A 50-ton concentrating mill was erected in 1910 for the treatment of Kineo lead ores, which were tested. The Emma Darling and the Blue Eyed Maggie properties were also producers of lead ore.

RAVALLI COUNTY.

Curlew district.—One shipment of sulphide ore from the Victor Orchard property was made, yielding gold, silver, copper, lead, and zinc. No development work was performed.

Frog Pond Basin.—Lead carbonate ore, with good values in gold and silver and a little copper, was shipped from the Gold Leaf property. The post office of the mine is at Phillipsburg.

Hughes Creek district.—Only 1 placer operator reported production from this district in 1910.

SANDERS COUNTY.

Four deep mines produced 466 tons of ore in 1910, containing $945 in gold, 5,641 ounces of silver, 36,738 pounds of copper, and 72,229 pounds of lead, valued in all at $11,835, an average value of $25.40 per ton. The bulk of the ore, aggregating 414 tons, was shipped to smelters and the remainder, treated at a milling plant, produced bullion and concentrate. A larger part of the ore shipped was that mined from the King & Queen property in 1909. The ore was roasted before shipment.

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SILVER BOW COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.....fine ounces..	39,443.43	$815,368	37,014.37	$765,155	− 2,429.06	− $50,213
Silver.....do....	10,609,328	5,516,850	10,400,840	5,616,454	− 208,488	+ 99,604
Copper.....pounds..	311,323,650	40,472,074	284,264,862	36,101,637	−27,058,788	−4,370,437
Lead.....do....	199,056	8,559	350,173	15,408	+ 151,117	+ 6,849
Zinc.....do....	9,299,154	502,154	31,620,184	1,707,490	+22,321,030	+1,205,336
Total.....	.....	47,315,005	.....	44,206,144	.....	−3,108,861

Eighty-three mine operators in 1910, against 71 in 1909, produced 4,709,429 tons of ore, 290,633 tons less than in 1909. The total average value per ton decreased from $9.46 in 1909 to $9.38 in 1910, and the gold and silver average value of this ore per ton increased from $1.26 to $1.35. Owing to curtailment in the production of copper ore in 1910, the tonnage of that class of ore was 4,516,317 tons, against an output of 4,961,187 tons in 1909. The zinc ore produced increased from 34,463 tons in 1909 to 169,165 tons in 1910, and the lead ore from 315 tons to 423 tons. The production of dry or siliceous ore increased from 4,097 tons in 1909 to 23,384 tons in 1910. In 1910 there were 140 tons of copper-lead ore produced, none of which class was reported in 1909. The largest part of the total tonnage, consisting of copper ore, was treated at the concentration plants at Anaconda, and the zinc ores were treated at Butte and Basin. The quantity of ore treated at concentration mills decreased from 4,401,628 tons in 1909 to 4,138,698 tons in 1910, and the yield of concentrates also decreased from 1,308,202 tons to 1,277,588 tons. Gold, silver, copper, lead, and zinc were contained in the concentrates produced in 1909 and 1910, averaging in value $28.67 and $27.19 per ton, respectively. Zinc concentrates contained gold, silver, and lead, and were shipped to eastern plants, the zinc being distilled from the concentrate and the residue smelted. Ore shipped directly to smelters aggregated 556,423 tons in 1910, as against 569,084 tons in 1909. The larger part was copper ore, and a small quantity of crude lead and zinc ore was included in the shipments, which, in 1910, aggregated in value $8,833,733 and had an average value of $15.88 per ton. In 1909 the average value of ore shipped directly to smelters was $15.32 per ton. Included with the smelting ores were 13,910 tons of slag and flue dust; also included in the production were the copper precipitates from mine waters and tailings. From the slag and flue dust 171,498 pounds of copper were recovered, and the copper precipitates contained 4,558,847 pounds of copper. The placer production of the county aggregated $2,498 in gold and 18 ounces of silver, against an output in 1909 of $5,867 in gold and 68 ounces of silver.

Divide Creek district.—This district embraces Soap Gulch, Moose, and Camp creeks. The principal deep mines producing in 1910

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were the Gold King, Backbone-Arctic, Clipper, Columbia, Combination, and Gold Hill properties. Two of the producers reported the milling of 230 tons of ore, which yielded gold and silver bullion. The remainder of the ore output, containing gold, silver, and copper, was shipped directly to the smelters. Three placer operators reported a production of $157 in gold. Developments at the head of Moose Creek on the Gold Hill or Free Gold property are important and a 75-ton mill equipped for the cyanide process has been built.

German Gulch district.—Three placer operators reported the production of $2,169 in gold and 15 ounces of silver. The placer output is partly estimated, as there were a number of transitory miners taking out gold.

Summit Valley district.—There were 76 deep-mine operators reporting production in 1910, against 58 in 1909. There was a greater number of lessees operating in the district than in 1909. The output of the county, with the exception of that for Divide Creek and German Gulch districts, is that of this region, which embraces all of Butte and Independence sections. During the latter part of 1910 a curtailment in production of copper was put into effect by the Anaconda Co. at its 2 smelters, reducing the output of the Washoe plant to about 16,000,000 pounds a month and that of the Great Falls smelter to about 6,000,000 pounds. Development continued at the Anaconda and allied mines, and it is reported some high-grade ore bodies were opened up on the deep levels. There was no curtailment of the development work, and all the mines of the group were working with the exception of the St. Lawrence and portions of the Anaconda and the Neversweat. On the 1,800-foot level of the West Colusa, and on two levels above, an ore body of large dimensions and of high grade was opened. In the Minnie Healy mine and to within 40 feet of the workings of the West Colusa a large body of copper ore was developed. Both the Minnie Healy and the Rarus were worked through the Tramway shaft, which has been sunk to a depth of 2,000 feet, where a station has been opened, and mining is again proceeding in the property. The work of connecting the large 4-compartment shaft of the Belmont with all the levels of the Anaconda mine proceeded throughout 1910 and this shaft will be put in operating condition to the 2,400-foot level. The fire in certain parts of the mine caused but little delay during 1910, and some ore mined in the lower levels was raised through the St. Lawrence and the Neversweat shafts. The latter is 2,500 feet deep. The St. Lawrence shaft is to be used for a new drainage system of all the mines, and will be sunk to the 2,800-foot level. The crosscut south on the 2,800-foot level of the High Ore shaft was driven to a point vertically under the Anaconda shaft and connected by diamond drill holes with the bottom of that shaft, and a connection will eventually be made, by means of an upraise, with the bottom of the Anaconda shaft. The Original mine, which was consolidated with the Anaconda interests in May, 1910, was vigorously developed, and large bodies of high-grade copper ore were reported on the 2,300-foot and 2,400-foot levels. Both eastward and westward connections were being made with the levels of the Gagnon shaft at several points, it being the intention to hoist all ores in the vicinity of the Original and Gagnon shafts through the Original shaft, which is equipped with all modern hoisting appliances. The Badger State

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shaft of the Boston & Montana mines is situated in a different section of the Butte camp, north from that in which are located the other shafts, and is now 1,800 feet in depth, 283 feet having been sunk during the year. Several veins of great promise are said to have been developed. In all there were 33.1 miles of development work in the form of drifts, crosscuts, upraises, winzes, and shafts performed in the Anaconda group of mines in 1910. The annual published statement of the Anaconda Co. reports the sinking of shafts to additional depths aggregating 3,765 feet, and its mines produced in 1910 ore aggregating 3,326,227 tons, and copper precipitates recovered from mine waters were 4,413 tons additional. An important improvement in hoisting the ore is the addition of a compressed-air plant, which should be in operation early in 1911. It is proposed to do all the hoisting by means of compressed air generated at this plant, and it is expected to reduce operating costs materially; and a further reduction of costs may be attained by the use of electrically driven pumps. The doing away with steam boilers and consequently with the use of coal will be an event of much importance. The new plant, operated by electricity brought 130 miles from Great Falls, consists of three Nordberg air compressors. At the reduction works, refinements in operation, tending toward lessened costs, were carried on during 1910 with a small unit of a new centrifugal concentrating device, which promises well. In the curtailment of copper production a number of men were dismissed, and the number would appear large in almost any other labor-employing community, but in Butte there are normally employed from 12,000 to 15,000 men in the mines and smelters, and the temporary discharge of 1,000 to 2,000 is not a large proportion of the whole. The curtailment was not made in ore output, but in the smelter production of copper, as it has, under the merger, been reported possible to treat a lower grade of ore at a better profit than formerly. The copper output of the smelters was reduced in 1910 about 15 per cent, and the ore output not quite 5 per cent. It has been stated that the Anaconda cost has been as low as 8¼ cents per pound, and that an average can be easily maintained at 9 cents per pound. In addition to voluntary curtailment on the part of the Anaconda and allied companies, there were several instances of forced curtailments of importance. The litigation started by the Anaconda against the Butte-Balaklava is said to have cut off, by injunction, nearly 700,000 pounds of copper per month. The Anaconda interests also stopped shipments by lessees from the Ticon mine, reducing the total output 120,000 pounds of copper a month more. The suit of the North Butte Co. against the Tuolumne reduced the latter's production more than half. The Tuolumne shaft is 1,400 feet in depth and is being sunk to 2,000 feet. Extensive development of several veins in the North Butte property was productive of a large tonnage of first and second class copper ore, which was shipped to the Washoe mill and smelter. Its Speculator shaft was completed to the 2,400-foot level in 1910, and sinking was continued to the 2,800-foot level. The East Butte-Pittsmont mine is now the only independent copper producer in the Butte district, the operators treating at their smelter their own ores and some custom material. Operations during 1910 were largely confined to the Pittsmont mine, where a new ore body on the 800-foot level was reported to be 40 feet wide, averaging better than 10 per

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cent of copper and 4 ounces of silver per ton. Another mine has been added to the producing class in the Butte-Alex Scott. Developments on the 1,200-foot, 1,500-foot, and 1,600-foot levels show a large quantity of copper ore of shipping grade, of which important shipments were made during 1910. At the Ophir mine the shaft is 500 feet deep and sinking has been resumed to reach 1,000 feet. On the 500-foot level silver ore carrying some gold has been developed. Experiments by concentration and cyanide processes were being tried on the ores, and several shipments were made for the tests.

NEVADA.

By V. C. Heikes.

PRODUCTION.

In Nevada for the calendar year 1910, 540 mines produced ore that was shipped or treated at mills; the remaining producing mines, 68 in number, were placers. The total output of gold, silver, copper, lead, and zinc was valued at $34,152,148, an increase of $4,079,216 over the corresponding value for 1909. There was an increase in output of all the metals except lead and zinc. In 1910 gold recovered from ore and placers aggregated $18,878,864, which was $2,638,901 greater than in 1909, when the output of gold, valued at $16,239,963, was $4,877,022 greater than in 1908. Mines in the Goldfield district, in Esmeralda County, in 1910 yielded $11,137,150 in gold; in Tonopah, in Nye County, $2,303,702; and Humboldt County, in which Seven Troughs and the new camp of National are situated, yielded $1,458,486. The increase in production of copper, which was second in total value, was notable and the bulk produced from one mine in the Robinson or Ely district, of White Pine County, exceeded all previous Nevada records. In 1910 the State yield of copper aggregated 64,359,398 pounds, and was 6,382,921 pounds greater than in 1909. Tonopah district, in Nye County, produced silver aggregating 10,422,869 ounces, or about 84 per cent of the total silver produced, which was 12,479,871 ounces in 1910. Compared with 1909, the yield of silver increased 1,498,810 ounces in 1910. The lead output was affected by the decreased yield in Eureka and Mineral counties, and the zinc production was less on account of operators of several properties in the Yellow Pine district, in Clark County, holding the ore mined for treatment in a new milling plant that was in process of erection in 1910. Concentrates produced in 1910 aggregated 233,913 tons, averaging $46.66 per ton, and contained gold, silver, copper, and lead, with a total value of $10,914,514. Copper in concentrates formed the largest part of the values and aggregated $7,928,963. Crude ore shipped to smelters, containing gold, silver, copper, lead, and zinc, aggregated 104,562 tons, valued at $4,501,062, at an average value of $43.05 per ton. At milling plants equipped principally with the cyanide process 1,130,750 tons of ore and 73,254 tons of old tailings were treated, yielding gold and silver valued at $18,572,230, and at an average value of $16.42 per ton. The statement of production for 1909 and 1910, showing increases and decreases and valued at each year's commercial prices, is as follows:

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Mine production of gold, silver, copper, lead, and zinc in Nevada in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	785,608.21	$16,239,963	913,265.05	$18,878,864	+ 127,656.84	+$2,638,901
Silver.....do....	10,981,061	5,710,152	12,479,871	6,739,130	+ 1,498,810	+ 1,028,978
Copper.....pounds..	57,976,477	7,536,942	64,359,398	8,173,643	+ 6,382,921	+ 636,701
Lead.....do....	9,840,791	423,154	4,871,130	214,329	− 4,969,661	− 208,825
Zinc.....do....	3,013,352	162,721	2,707,071	146,182	− 306,281	− 16,539
Total.....	.....	30,072,932	.....	34,152,148	.....	+ 4,079,216

Nevada's production of ore and its content for seven years is as follows:

Tons of ore sold or treated in Nevada in 1904–1910, and total content of gold, silver, copper, lead, and zinc.

Year.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1904.....	323,670	244,801.18	4,268,123	29,317	4,229,727	.....	$7,658,216
1905.....	432,202	254,927.51	6,482,081	413,235	3,457,124	697,757	9,453,114
1906.....	496,307	506,520.31	6,770,611	1,625,985	3,823,617	2,886,328	15,714,841
1907.....	723,581	585,311.14	7,083,603	1,782,571	6,271,341	2,168,783	17,591,486
1908.....	1,425,532	549,682.27	9,508,464	15,598,788	7,245,619	1,115,851	18,818,228
1909.....	2,982,607	785,608.21	10,981,061	57,976,477	9,840,791	3,013,352	30,072,932
1910.....	3,655,775	913,265.05	12,479,871	64,359,398	4,871,130	2,707,071	34,152,148

At McGill, Nev., the Steptoe smelter was in active operation, treating concentrate from the Nevada Consolidated mines during 1910. A smelting plant situated near Nelson, in Clark County, and one at Spruce, in Elko County, were idle. In Ormsby and Mineral counties copper furnaces were being erected, both for the treatment of custom ores and of ores from mines owned by the smelter interests.

ORE PRODUCTION IN 1910.

Ore mined in 1910 aggregated 3,655,775 tons. The production increased 673,168 tons in quantity, but decreased in total value per ton from $10.05 in 1909 to $9.30 in 1910, and the gold and silver value in this ore decreased from $7.33 to $6.96. Production of dry or siliceous ores increased from 1,229,651 tons in 1909 to 1,258,394 tons in 1910. The greatest quantity of this kind of ore was produced in Nye County, whose output in 1910 was 524,548 tons against 426,089 tons in 1909. Esmeralda County was the next largest producer, with 522,999 tons in 1910, against 460,116 tons in 1909. The output of copper ore increased from 1,670,457 tons in 1909 to 2,375,490 tons in 1910. White Pine County produced practically all of it. Lead ore production decreased in quantity from 76,837 tons in 1909 to 16,805 tons in 1910; the output of zinc ore increased from 2,882 tons in 1909 to 3,038 tons in 1910; that of copper-lead ore decreased from 1,021 tons in 1909 to 385 tons in 1910; and that of lead-zinc ore from 1,759 tons in 1909 to 1,663 tons in 1910. The average yield per ton of gold and silver in dry or sili-

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ceous ores in 1910 was $19.51, against $16.58 in 1909; in copper ore, 21 cents, against 24 cents in 1909; in lead ore, $23.62, against $13.74 in 1909; in copper-lead ore, $17.19, against $8.21 in 1909; and in lead-zinc ore, $1.97, against $5.08 in 1909. The following table shows the tonnage of the different classes of ore sold or treated in 1910, with the average value per ton in gold and silver for each kind, and the increase and decrease in tonnage:

Subdivision of tonnage of ore sold or treated in Nevada in 1910, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Churchill	1,110	.....	50	.....	4	.....	1,164
Clark	27,381	689	869	3,038	.....	1,663	33,640
Douglas and Ormsby	24	.....	.....	.....	.....	.....	24
Elko	4,042	.....	289	.....	129	.....	4,460
Esmeralda	522,999	500	483	.....	.....	.....	523,982
Eureka	3,863	.....	8,114	.....	.....	.....	11,977
Humboldt	6,324	.....	280	.....	44	.....	6,648
Lander	12,362	.....	9	.....	113	.....	12,484
Lincoln	1,709	67	2,534	.....	.....	.....	4,310
Lyon	11,117	.....	.....	.....	.....	.....	11,117
Mineral	15,948	18	2,777	.....	.....	.....	18,743
Nye	524,548	.....	20	.....	8	.....	524,576
Storey	108,592	.....	.....	.....	.....	.....	108,592
Washoe	3,595	.....	77	.....	.....	.....	3,672
White Pine	14,780	2,374,216	1,303	.....	87	.....	2,390,386
Total	1,258,394	2,375,490	16,805	3,038	385	1,663	3,655,775
Average value per ton in gold and silver	$19.51	$0.21	$23.62	$0.96	$17.19	$1.97	$6.96

GOLD.

Gold production from bullion and cyanide precipitates from quartz milling carried on in 16 counties in 1910 showed an increased yield over the output of 1909, principally from the operation of the Goldfield and Tonopah mines in Esmeralda and Nye counties, which, combined, yielded $13,440,852 in gold. This gold was 61 per cent of the total from placers and quartz gold produced in Nevada during 1910. The total output of gold amounted to $18,878,864, which was $2,638,901 more than the output of 1909. Sixty-eight placers produced $162,371 in gold, twice the amount reported by 41 operators in 1909. The increase was the greatest in Nye County, where the Manhattan and the Round Mountain placers are situated; the yield of $136,281 in gold and silver in 1910 was more than twice the value reported in 1909, which was $60,876. This is considered low, as more recent information, received after the 1909 mine-production report was printed, shows that the total yield of gold from placers in the Manhattan camp in 1909 was about $20,000 greater than had been reported. There was a notable increase in gold recovered from dry placers in the Rawhide camp of Mineral County. Decreases were recorded in Elko, Esmeralda, Eureka, and White Pine counties. At amalgamation and cyanide mills $15,051,983 in gold were produced, averaging $12.50 per ton of ore and tailings treated. Ores treated at concentration mills producing concentrates contained $1,585,460 in gold, averaging $6.78 per ton. The crude ore of shipping grade to smelters contained $2,079,050 in gold and averaged $19.88 per ton.

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Source of gold product in Nevada in 1910, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Churchill	.....	2,079.96	.....	3.11	.....	0.04	.....	2,083.13
Clark	.....	10,091.71	492.65	9.54	3.75	.....	5.71	10,603.36
Douglas and Ormsby	.....	27.58	.....	.....	.....	.....	.....	27.58
Elko	27.96	2,066.21	.....	8.30	.....	.25	.....	2,102.72
Esmeralda	23.75	579,603.72	420.36	178.27	.....	.....	.....	580,226.10
Eureka	247.49	1,252.89	.....	2,441.65	.....	.....	.....	3,942.03
Humboldt	111.17	70,277.00	.....	165.29	.....	.80	.....	70,554.26
Lander	272.21	1,735.44	.....	.....	.....	.54	.....	2,008.19
Lincoln	.....	791.83	.....	895.30	.....	.....	.....	1,687.13
Lyon	10.93	5,698.77	.....	.....	.....	.....	.....	5,709.70
Mineral	579.77	8,187.17	7.82	112.79	.....	.....	.....	8,887.55
Nye	6,561.63	170,585.29	.....	.57	.....	.16	.....	177,147.65
Storey	.....	24,325.03	.....	.....	.....	.....	.....	24,325.03
Washoe	19.79	1,804.67	.....	1.45	.....	.....	.....	1,825.91
White Pine	.....	1,653.64	20,310.04	150.80	.....	20.23	.....	22,134.71
Total	7,854.70	880,180.93	21,230.87	3,967.07	3.75	22.02	5.71	913,265.05
Increase (+) or decrease (−)	+3,841.27	+131,748.03	+3,541.54	−11,489.08	+3.75	+8.28	+3.05	+127,656.84

SILVER.

In 1910 the output of silver amounted to 12,479,871 fine ounces, valued at $6,739,130. Compared with the figures of 1909, this indicated an increase of 1,498,810 ounces in quantity and of $1,028,978 in value. The increased yield was from siliceous ores treated in Nye County and from copper ores in White Pine County. Tonopah mines in Nye County were credited with more than eight-tenths of the total silver produced. Siliceous ores yielded 11,763,012 ounces, against 9,456,840 ounces in 1909. Silver production from copper ores aggregated 107,365 ounces, which was about a third more than in 1909 and came chiefly from ores treated near Ely, in White Pine County. Silver production from zinc ores was not classified in 1909, but the separation was made for 1910 and shows that 5,281 ounces were recovered; from lead-zinc ores 5,863 ounces were recovered, which was 11,210 ounces less than was recorded in 1909. From copper-lead ores the decrease was from 15,580 ounces in 1909 to 11,413 ounces in 1910. The crude ore treated at smelters yielded 3,380,037 ounces, averaging 32.32 ounces per ton. The concentrates produced at milling plants contained 2,577,203 ounces, or an average of 11 ounces per ton. Cyanide and amalgamation mills treated ore and tailings yielding 6,518,976 ounces, or an average of 5.41 ounces per ton.

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Source of silver product in Nevada in 1910, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Churchill	.....	160,400	.....	2,100	.....	41	.....	162,541
Clark	.....	10,220	5,055	4,231	5,281	.....	5,863	30,650
Douglas and Ormsby	.....	22	.....	.....	.....	.....	.....	22
Elko	18	9,676	.....	5,839	.....	3,125	.....	18,658
Esmeralda	22	157,404	2,218	39,059	.....	.....	.....	198,703
Eureka	18	2,927	.....	33,102	.....	.....	.....	36,047
Humboldt	70	267,844	.....	11,258	.....	1,460	.....	280,632
Lander	46	73,258	.....	112	.....	5,716	.....	79,132
Lincoln	.....	14,864	999	38,708	.....	.....	.....	54,571
Lyon	6	10,525	.....	.....	.....	.....	.....	10,531
Mineral	467	95,460	194	426,866	.....	.....	.....	522,987
Nye	2,999	10,545,980	.....	1,121	.....	223	.....	10,550,303
Storey	.....	320,716	.....	.....	.....	.....	.....	320,716
Washoe	9	4,786	.....	10,361	.....	.....	.....	15,156
White Pine	.....	88,950	98,899	10,525	.....	848	.....	199,222
Total	3,655	11,763,012	107,365	583,282	5,281	11,413	5,863	12,479,871
Increase (+) or decrease (−)	+2,121	+2,306,172	+ 32,747	−832,134	+5,281	−4,167	−11,210	+1,498,810

COPPER.

The yield of copper in 1910 was 64,359,398 pounds, valued at $8,173,643. As compared with the figures of 1909, this showed an increase of 6,382,921 pounds, which was credited almost entirely to White Pine County. In 1909 the beginning of a normal production on a large scale of the mines in this county at Ely was the cause of the total yield reaching 57,976,477 pounds, which was 42,377,689 pounds greater than in 1908, when the production was 15,598,788 pounds. Crude ore shipped to smelters in 1910 yielded 1,926,619 pounds, or an average of 18.42 pounds per ton. Concentrates contained 62,432,779 pounds of copper, an average of 266.99 pounds per ton. The average content of the copper ores classified as such in 1910 was 27 pounds per ton. Copper-lead ores carried 77.80 pounds per ton; lead ore, 4.06 pounds per ton; lead-zinc ore, 0.47 pound per ton; and siliceous ore, 0.08 pound per ton.

Source of copper production in Nevada, by kinds of ore, in 1910, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Churchill	2,047	.....	.....	370	.....	2,417
Clark	8,785	205,041	2,157	.....	790	216,773
Elko	.....	.....	776	8,992	.....	9,768
Esmeralda	79,360	42,992	241	.....	.....	122,593
Eureka	19	.....	702	.....	.....	721
Humboldt	2,034	.....	478	4,670	.....	7,182
Lander	4,579	.....	94	6,710	.....	11,383
Lincoln	219	6,581	853	.....	.....	7,653
Mineral	922	2,990	43,463	.....	.....	47,375
Nye	913	.....	183	942	.....	2,038
Storey	573	.....	.....	.....	.....	573
Washoe	.....	.....	644	.....	.....	644
White Pine	9,622	63,893,647	18,738	8,271	.....	63,930,278
Total	109,073	64,151,251	68,329	29,955	790	64,359,398

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LEAD.

The output of lead in 1910 amounted to 4,871,130 pounds, valued at $214,329, against 9,840,791 pounds, valued at $423,154 in 1909. Mines in 13 counties supplied the lead. The lowest production was from Storey County, with 1,871 pounds, and the highest output, 1,309,684 pounds, came from Clark County. The average content of lead ores classified as such in 1910 was 233.68 pounds per ton. Siliceous ores carried 0.14 pound per ton; copper ore, 0.01 pound per ton; zinc ore, 38.98 pounds per ton; copper-lead ore, 487.41 pounds per ton; and lead-zinc ore, 257.39 pounds per ton. Crude ore shipped to smelters contained 4,680,198 pounds, an average of 44.76 pounds per ton. Nearly all the shipping ore contained lead, except a comparatively small tonnage of high-grade gold siliceous ore from Goldfield and high-grade siliceous ore from Tonopah. Concentrate contained 190,932 pounds of lead, produced from mills in 9 counties, and averaged 0.82 of a pound per ton. Mills in White Pine and Lincoln counties were the largest producers.

Source of lead production in Nevada, by kinds of ore, in 1910, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Churchill	.....	.....	30,000	.....	1,602	.....	31,602
Clark	22,277	24,804	716,120	118,428	.....	428,055	1,309,684
Elko	50	.....	146,214	.....	55,367	.....	201,631
Esmeralda	7,369	.....	145,941	.....	.....	.....	153,310
Eureka	559	.....	672,242	.....	.....	.....	672,801
Humboldt	7,788	.....	80,264	.....	19,011	.....	107,063
Lander	9,839	.....	2,862	.....	68,367	.....	81,068
Lincoln	13,592	.....	921,663	.....	.....	.....	935,255
Mineral	16,234	.....	695,283	.....	.....	.....	711,517
Nye	4,357	.....	3,954	.....	6,708	.....	15,019
Storey	1,871	.....	.....	.....	.....	.....	1,871
Washoe	.....	.....	63,720	.....	.....	.....	63,720
White Pine	101,096	9	448,885	.....	36,599	.....	586,589
Total	185,032	24,813	3,927,148	118,428	187,654	428,055	4,871,130

ZINC.

The mine production of zinc in 1910, calculated as spelter, amounted to 2,707,071 pounds, valued at $146,182. Compared with 1909, the output decreased 306,281 pounds in quantity and $16,539 in value. Clark County was credited with the entire yield, which was reported by 10 operators in the Yellowpine district who shipped the zinc ore direct to eastern zinc works, and lead-silver ore, containing zinc, to Salt Lake smelters. Zinc was paid for in two classes of ore, a clean zinc carbonate and silicate and a mixed zinc-lead-silver ore. Sometimes the operator received a better price for the mixed ore for its zinc than for the lead-silver content, or vice versa. The desirability of this ore for use in the manufacture of zinc-lead paint brought about a market for the zinc-lead-silver ore, of which 1,663 tons were shipped in 1910, containing 5.71 ounces of gold, 5,863 ounces of silver, 790 pounds of copper, 428,055 pounds of lead, and 817,803 pounds of zinc. The clean carbonate and silicate aggregated 3,038 tons, containing 3.75 ounces of gold, 5,281 ounces of silver, 118,428 pounds of lead,

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1,889,268 pounds of zinc, and no copper. With the prospect of railroad and milling facilities in 1911, the zinc mine operators are of the opinion that the output of Clark County will be greatly increased.

MINING INDUSTRY IN NEVADA IN 1910.

Most of the camps in Nevada were comparatively quiet throughout the year, and in the more active districts progress was represented by the operations of the larger mines or by mergers or consolidations of smaller companies into corporations having sufficient capital to develop the amassed holdings on a larger scale. Shippers of ore depend on the markets at Salt Lake, in Utah, and at Vallejo, Needles, Kennett, and Martinez, in California. Gradually the tonnage of shipping ores has been lessened, and instead the product in the form of gold and silver bullion and concentrate produced by the mills are shipped. Mill building and development of low to medium grade properties is notably under way in the Manhattan and Round Mountain districts, Nye County; in the El Dorado district, Clark County; in the Rawhide district, Mineral County; in the Hornsilver district, Esmeralda County; in the Yellow Pine zinc district, Clark County; at National, Humboldt County; and at Austin, in Lander County. The Comstock mines are increasing their production of silver. Pioche is reviving and soon is to have milling facilities. A 100-ton mill was completed at Gold Mountain, Esmeralda County, which is to handle the ores of that district and the output of the two developed properties of Hornsilver, while a mill for Hornsilver camp itself was to be constructed in the near future. A new mill was to be built on one of the Goldfield properties, and a 50-ton plant was being erected at Railroad Springs, 20 miles from Goldfield. Fifteen miles from Tonopah the Liberty Mining Co. has a 100-ton mill at work, and in the Bullfrog district no less than 7 small mills were either dropping stamps or under construction. The new camp of Jarbidge, in the northern part of Elko County, attracted considerable interest in 1910, and the Bannock placers, south of Battle Mountain, in Lander County, were productive of some large gold nuggets. Some discoveries of low-grade ore were made in the new camp of Buckhorn, about 20 miles due west of Alpha, a station on the Eureka & Palisade Railroad, 50 miles south of Palisade. The washing out of a part of the roadbed in February, 1910, seriously handicapped the miner and also the old Richmond-Eureka mines at Ruby Hill. The production of ore ceased entirely for the rest of the year. Pioche mine operators, in Lincoln County, were also without railroad facilities for nearly all of 1910, caused by the washing out of the San Pedro, Los Angeles & Salt Lake Railroad. In the Mason Valley, or Yerington district, considerable development work was being carried on, and interest was centered in the completion of the Nevada Copper Belt Railroad from Wabuska, on the Southern Pacific, to Yerington and Mason; and also in the erection of a new smelter at Wabuska. The mines of the famous Comstock lode, in Storey County, continue to make annual production from the workings above water level. It is reported that substantial progress was made in 1910 in exploring the territory east of the larger workings.

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Mine production of gold, silver, copper, lead, and zinc in Nevada in 1910, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Churchill	2,083.13	$43,062	162,541	$87,772	2,417	$307
Clark	10,603.36	219,191	30,650	16,551	216,773	27,530
Douglas and Ormsby	27.58	570	22	12	.....	.....
Elko	2,102.72	43,467	18,658	10,076	9,768	1,240
Esmeralda	580,226.10	11,994,338	198,708	107,300	122,593	15,569
Eureka	3,942.03	81,489	36,047	19,466	721	91
Humboldt	70,554.26	1,458,486	280,632	151,541	7,182	912
Lander	2,008.19	41,513	79,132	42,731	11,383	1,446
Lincoln	1,687.13	34,876	54,571	29,468	7,653	972
Lyon	5,709.70	118,030	10,531	5,686	.....	.....
Mineral	8,887.55	183,722	522,987	282,413	47,375	6,017
Nye	177,147.65	3,661,967	10,550,303	5,697,163	2,038	259
Storey	24,325.03	502,843	320,716	173,187	573	73
Washoe	1,825.91	37,745	15,156	8,184	644	82
White Pine	22,134.71	457,565	199,222	107,580	63,930,278	8,119,145
Total	913,265.05	18,878,864	12,479,871	6,739,130	64,359,398	8,173,643

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Churchill	31,602	$1,390	.....	.....	$132,531
Clark	1,309,684	57,626	2,707,071	$146,182	467,080
Douglas and Ormsby	.....	.....	.....	.....	582
Elko	201,631	8,872	.....	.....	63,655
Esmeralda	153,310	6,746	.....	.....	12,123,953
Eureka	672,801	29,603	.....	.....	130,649
Humboldt	107,063	4,711	.....	.....	1,615,650
Lander	81,068	3,567	.....	.....	89,257
Lincoln	935,255	41,151	.....	.....	106,467
Lyon	.....	.....	.....	.....	123,716
Mineral	711,517	31,307	.....	.....	503,459
Nye	15,019	661	.....	.....	9,360,050
Storey	1,871	82	.....	.....	676,185
Washoe	63,720	2,803	.....	.....	48,814
White Pine	586,589	25,810	.....	.....	8,710,100
Total	4,871,130	214,329	2,707,071	146,182	34,152,148

Tonnage of ore sold or treated, number of deep mines producing, and average value per ton of gold in Nevada in 1909 and 1910, by counties.

County.	Ore sold or treated (short tons).		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	1910	Increase (+) or decrease (−).	1909	1910	1909	1910	1909	1910
Churchill	1,164	− 47	8	15	$90.57	$113.86	$89.63	$112.40
Clark	33,640	− 44,008	22	36	7.04	13.88	4.66	7.01
Douglas and Ormsby	24	− 47	2	4	12.25	24.25	7.68	24.25
Elko	4,460	− 7,734	30	35	16.04	14.14	13.51	11.87
Esmeralda	523,982	+ 72,067	39	79	23.06	23.14	23.04	23.09
Eureka	11,977	− 76,364	23	8	8.12	10.48	5.86	8.00
Humboldt	6,648	− 4,896	46	71	36.85	242.67	36.56	241.83
Lander	12,484	+ 10,404	17	16	35.93	6.70	34.52	6.29
Lincoln	4,310	− 99,875	17	18	5.16	24.70	4.32	14.93
Lyon	11,117	− 7,434	19	28	6.24	11.11	6.24	11.11
Mineral	18,743	+ 1,955	39	68	51.28	26.21	46.83	24.22
Nye	524,576	+ 98,155	59	95	16.83	17.58	16.82	17.56
Storey	108,592	+ 16,500	22	26	8.88	6.23	8.88	6.23
Washoe	3,672	− 566	11	17	6.77	13.18	6.77	12.39
White Pine	2,390,386	+ 715,058	22	24	4.75	3.64	.26	.24
Total	3,655,775	+ 673,168	376	540	10.05	9.30	7.33	6.96

[a] Value per ton, placer product excluded.

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Tonnage of ores to gold and silver mills and concentrating mills, with gold and silver contained in bullion produced in Nevada in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Churchill	13	19.18	56	.....
Clark	27,008	9,483.39	8,330	.....
Douglas and Ormsby	22	19.91	19	.....
Elko	1,434	1,988.51	9,266	.....
Esmeralda	509,840	494,982.65	81,678	114
Eureka	3,789	947.43	233	.....
Humboldt	6,147	69,816.35	182,974	.....
Lander	71	312.35	41,939	411
Lincoln	592	782.44	4,606	.....
Lyon	10,984	5,339.60	10,183	.....
Mineral	15,504	7,148.99	54,204	.....
Nye	477,223	123,989.30	5,956,338	.....
Storey	59,826	11,316.06	162,340	.....
Washoe	3,536	1,681.57	747	.....
White Pine	14,761	311.94	6,063	2,346,684
Total	1,130,750	728,139.67	6,518,976	2,347,209

Mine production of gold, silver, copper, and lead from Nevada concentrates in 1910, by counties.

County.	Concentrates produced.					Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Elko	4	4.12	276	.....	50	$236
Esmeralda	16,883	25,678.47	45,024	78,530	6,188	565,379
Humboldt	75	158.88	5,927	1,898	5,653	6,975
Lander	63	73.89	7,087	.....	1,890	5,762
Lincoln	43	5.05	388	.....	21,744	1,270
Lyon	122	346.79	338	.....	.....	7,352
Mineral	62	192.94	9,202	61	13,160	9,545
Nye	3,348	16,796.56	2,176,100	913	4,357	1,522,618
Storey	1,229	12,400.36	150,384	573	1,871	337,700
Washoe	.....	.....	.....	.....	.....	.....
White Pine	212,084	21,039.56	181,877	62,350,804	136,019	8,457,677
Total	233,913	76,696.62	2,577,203	62,432,779	190,932	10,914,514

Mine production of gold, silver, copper, lead, and zinc from Nevada crude ore shipped to smelters in 1910, by counties.

County.	Crude ore to smelter.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Churchill	1,151	2,063.95	162,485	2,417	31,602	.....	$132,105
Clark	6,632	1,119.97	22,320	216,773	1,309,684	2,707,071	266,543
Douglas and Ormsby	2	7.67	3	.....	.....	.....	160
Elko	426	82.13	9,098	9,768	201,581	.....	16,719
Esmeralda	3,863	59,541.22	71,979	44,063	147,122	.....	1,231,765
Eureka	8,188	2,747.11	35,796	721	672.801	.....	105,813
Humboldt	484	467.86	91,661	5,284	101,410	.....	64,302
Lander	697	1,349.74	29,460	11,383	79,178	.....	48,740
Lincoln	3,543	899.64	49,577	7,653	913,511	.....	86,535
Lyon	3	12.38	4	.....	.....	.....	258
Mineral	3,099	965.85	459,114	47,314	698,357	.....	304,624
Nye	47,353	29,800.16	2,414,866	1,125	10,662	.....	1,920,664
Storey	44	608.61	7,992	.....	.....	.....	16,897
Washoe	136	124.55	14,400	644	63,720	.....	13,237
White Pine	28,941	783.21	11,282	1,579,474	450,570	.....	242,700
Total	104,562	100,574.06	3,380,037	1,926,619	4,680,198	2,707,071	4,501,062

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Number of mines producing, classified by chief products, in Nevada in 1910, by counties.

County.	Placer mines.			Deep mines.												Total mines producing.
	Hydraulic, dry, and sluicing.	Drift.	Dredging.	Gold.	Silver.	Copper.	Lead.	Zinc.	Gold-silver.	Gold-silver-copper.	Gold-silver-copper-lead.	Gold-silver-copper-lead-zinc.	Gold-silver-lead.	Silver-copper.	Silver-lead.	
Churchill	....	....	....	2	....	....	....	....	10	1	1	....	1	....	....	15
Clark	....	....	....	....	....	....	1	5	18	1	3	[a]5	1	2	....	36
Douglas and Ormsby	....	....	....	1	....	....	....	....	3	....	....	....	....	....	....	4
Elko	2	....	....	1	....	....	....	....	25	....	3	....	5	....	1	37
Esmeralda	2	....	....	20	....	1	....	....	37	5	2	....	14	....	....	81
Eureka	4	1	....	....	....	....	....	....	1	1	1	....	5	....	....	13
Humboldt	4	....	1	1	1	....	....	....	54	2	5	....	7	....	1	76
Lander	8	2	....	....	....	....	....	....	10	....	4	....	1	[b]1	....	26
Lincoln	....	....	....	....	....	....	....	....	8	....	4	....	5	1	....	18
Lyon	....	1	....	....	....	....	....	....	28	....	....	....	....	....	....	29
Mineral	5	....	....	4	....	....	....	....	44	1	7	....	[c]10	1	1	73
Nye	30	7	....	3	....	....	....	....	86	....	3	....	1	[b]1	1	132
Storey	....	....	....	1	....	....	....	....	24	....	1	....	....	....	....	26
Washoe	1	....	....	1	....	....	....	....	15	....	1	....	....	....	....	18
White Pine	....	....	....	....	....	....	....	....	5	3	8	....	4	[b]2	2	24
Total	56	11	1	34	1	1	1	5	368	14	43	5	54	8	6	608

[a] Includes 2 silver-lead-zinc mines. [b] Reported also lead. [c] One reported no silver.

REVIEW BY COUNTIES.

CHURCHILL COUNTY.

The mines of this county, after a year of reduced output and comparative idleness, were the center of increased development work in 1910 as a direct result of mergers at Fairview and Wonder. The number of mines reported producing in 1910 almost doubled the number reported in 1909, and the total value of the output of gold, silver, copper, and lead was one-fifth greater. In 1910 15 deep mines produced, of which 10 produced only gold and silver. The total output of the county consisted of 1,164 tons of ore, the larger part of which was sorted, and contained $43,062 in gold, 162,541 ounces of silver, 2,417 pounds of copper, and 31,602 pounds of lead, valued in all at $132,531, or an average value of $113.86 per ton. In 1909 there were produced 1,211 tons of ore, averaging in value for the same metals $90.57 per ton. With the exception of 13 tons producing bullion, the remainder, or 1,151 tons, was shipped to smelters. No placer production was reported.

Fairview district.—In 1910 from 8 deep mines was reported a production of 1,153 tons of ore, yielding $42,557 in gold, 160,284 ounces of silver, 2,417 pounds of copper, and 31,602 pounds of lead, valued at $130,807, an average value of $113.44 per ton. The greater part of the output, consisting of oxidized and sulphide ores, was shipped directly to smelters and aggregated 1,142 tons, containing gold, silver, copper, and lead. A small tonnage was treated at an amalgamation mill. The largest producer was the Nevada Hills mine, in which a large body of sulphide ore was opened on the 400-foot level. This mine was consolidated early in 1910 with the Fairview-Eagle mine, and development work was resumed on a larger scale. Toward the close of 1910 preparations were being made to erect a mill.

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Jessup district.—Small shipments of gold and silver ore, aggregating 4 tons, were made from 3 properties in 1910.

CLARK COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Clark County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	16,594.41	$343,037	10,603.36	$219,191	−5,991.05	−$123,846
Silver.....do....	35,294	18,353	30,650	16,551	− 4,644	− 1,802
Copper.....pounds..	23,308	3,030	216,773	27,530	+ 193,465	+ 24,500
Lead.....do....	445,907	19,174	1,309,684	57,626	+ 863,777	+ 38,452
Zinc.....do....	3,013,352	162,721	2,707,071	146,182	− 306,281	− 16,539
Total.....	.....	546,315	.....	467,080	.....	− 79,235

Clark County made a smaller production in 1910 than in 1909, owing to the ore being held for treatment in a milling plant under construction and until the completion of the new railroad spur into the district. Both were under construction in 1911. Development work, during which zinc and lead-silver ores were shipped, was active about Goodsprings. The Eldorado district mines yielded well, and Searchlight also continued a good yield of gold and silver. Ore was produced in the county in 1910 from 36 deep mines, against 22 in 1909. In 1910 there were 33,640 tons of ore produced, having a total average value of $13.88 per ton, against 77,648 tons and an average value of $7.04 per ton in 1909. The average value of the gold and silver in this ore increased from $4.66 per ton in 1909 to $7.01 in 1910. The larger part of the ore, or 27,008 tons, produced gold and silver bullion, containing $196,039 in gold and 8,330 ounces of silver. No concentrate was produced in the county, but the shipments of crude ores directly to the smelters, consisting chiefly of zinc carbonate, aggregated 6,632 tons, containing $23,152 in gold, 22,320 ounces of silver, 216,773 pounds of copper, 1,309,684 pounds of lead, and 2,707,071 pounds of zinc, valued in all at $266,543, an average value of $40.19 per ton.

Eldorado Canyon district.—The yield of ore produced from 7 properties aggregated 431 tons, containing $2,875 in gold and 2,335 ounces of silver, having a total value of $4,136, at an average value of $9.60 per ton. Most of the ore produced was treated at milling plants, yielding gold and silver bullion, and 31 tons of gold and silver ore were shipped directly to the smelters. The largest production of ore was the output of the Queen mine, which was equipped with a Huntington mill and 3 stamps. The crushed ore is treated by the cyanide process in a 30-ton mill.

Searchlight district.—From the operations in 1910 of 13 properties 27,331 tons of ore were produced, containing $215,097 in gold, 11,489 ounces of silver, 93,848 pounds of copper, and 45,847 pounds of lead, with a total value of $235,237 and an average value of $8.61 per ton. Milling ore made up the larger part of the tonnage, yielding gold and silver bullion, and the remainder, aggregating 723 tons, was shipped directly to smelters and contained 994.16 ounces

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of gold, 4,927 ounces of silver, 93,848 pounds of copper, and 45,847 pounds of lead. Most of the milling ore was the yield of the Golden Treasure and Red Lyon groups, crushed in a 40-stamp mill and treated by the cyanide process in a 150-ton plant. Ore from the Chief of the Hills mine and other properties worked by lessees was milled in the Cyrus Noble 10-stamp mill, producing bullion.

Yellowpine district.—Jean, Arden, and Roach are shipping points for ore. Goodsprings, the principal camp, is the post office at the mines, and is reached by stage 8 miles west of Jean. Sixteen operators of deep mines reported 5,878 tons of ore, which yielded $1,219 in gold, 16,826 ounces of silver, 122,925 pounds of copper, 1,263,837 pounds of lead, and 2,707,071 pounds of zinc, having a total value of $227,707, at an average value of $38.74 per ton. All of this product was of shipping grade, the zinc ores, consisting largely of carbonates, being shipped to eastern zinc plants and the copper ore and lead-silver ore to the smelters near Salt Lake City. There were 6 shippers of copper ore, the output of which aggregated 280 tons, and 1 shipped a high-grade gold ore containing silver and lead. The production of lead ore, 869 tons in quantity, was shipped by 5 operators. It contained silver and a little gold and copper. Three operators shipped lead-zinc ore, aggregating 1,663 tons, which carried twice as much zinc as lead, gold, and copper. Zinc ore was produced from 8 properties and very little gold, silver, or lead was reported. The ore contained no copper. The Potosi, Yellowpine, and Prairie Flower—Goodsprings properties—were the largest producers of ore in 1910. All of the mines are dry, and water for all purposes is hauled to them from the nearest camp. The only water near the mines is at Goodsprings, where there is an excellent well. According to a description of the district written by Gregory,[1] the ores occur as replacements in limestone in an easily determined zone in lenses, chimneys, and shoots. Zinc is found always in the oxidized state, the ores occurring as the carbonate and silicate and as hydro-zincite, a whitish earthy basic zinc carbonate. Lead occurs as sulphide and carbonate. The mines are worked by shaft and tunnels. On the Yellowpine an incline shaft has been sunk 400 feet. The smaller producers, some of which produced shipping ore in 1910, are the Addison & Milford, the Sultan, Ingomar, Frederick Ward, Alice, Pilgrim, Anchor, Valentine, Robins & Chaffin, Taussach, Riley & Donohue, Kansas-Nevada, Hoosier, Whale, Green Monster, Gila Monster, Mobile, May, Kirby, Mountain Top, and the Blue Jay mines.

DOUGLAS COUNTY.

Reports were received from 3 deep mines producing gold and silver in this county in 1910. Bullion and a small tonnage of crude ore shipped to the smelters contained these metals. The gold and silver ore, which was principally sorted, was shipped to the smelters and averaged $80 in value per ton. No placer mining was reported in the county for the year.

Gardnerville district.—The yield of 11 tons of ore from 1 mine averaged $16.27 per ton for its gold and silver content, which was shipped in the form of bullion. The Evening Star mine and mill

[1] Gregory, Newman B., The Yellowpine mining district of Nevada: Eng. and Min. Jour., Dec. 31, 1910.

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were operated on test lots of ore. A vertical shaft sunk on the property is 100 feet deep and the mill is of a daily capacity of 40 tons.

Red Canyon district.—The larger part of ore from 2 mining claims yielded bullion, and the remainder, shipped to smelters, yielded an average of $26.67 per ton in gold and silver.

ELKO COUNTY.

Mine production of gold, silver, copper, and lead in Elko County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	6,123.07	$126,575	2,102.72	$43,467	−4,020.35	−$83,108
Silver.....do....	79,569	41,376	18,658	10,076	− 60,911	− 31,300
Copper.....pounds..	46,531	6,049	9,768	1,240	− 36,763	− 4,809
Lead.....do....	576,768	24,801	201,631	8,872	− 375,137	− 15,929
Total.....	.....	198,801	.....	63,655	.....	−135,146

There was a decrease in the production of the metals in this county in 1910. The decrease of gold is attributed to the idleness of the Lucky Girl mine in the Centennial district. Nearly all of the gold was produced from siliceous ores, with small quantities from lead ore and placer operations. The placers near Tuscarora produced gold valued at $578 and 18 ounces of silver. The ore shipped directly to smelters aggregated 426 tons, containing $1,697 in gold, 9,098 ounces of silver, 9,768 pounds of copper, and 201,581 pounds of lead, valued in all at $16,719, or an average value of $39.25 per ton. Mill bullion was produced from 1,434 tons of ore, containing $41,106 in gold and 9,266 ounces of silver. Only 4 tons of concentrate were were produced, containing gold, silver, and a small quantity of lead.

Dolly Varden district.—The entire production of the district, made by 3 mines, consisted of ore of shipping grade, aggregating 110 tons, which yielded $121 in gold, 3,365 ounces of silver, 776 pounds of copper, and 53,630 pounds of lead, valued at $4,396, at an average value of $39.96 per ton. The Kinsley mine was the largest producer of lead ore.

Ferber district.—The production of lead ore made by 1 mine in this district contained considerable silver and a small quantity of gold and averaged $48.53 per ton.

Gold Circle district.—Ores produced, aggregating 1,042 tons, from 12 mines in 1910, yielded $24,767 in gold and 1,152 ounces of silver, and also a small tonnage of concentrate, containing gold and silver. The total value of the production was $25,389, or an average value of $24.37 per ton. In 1909 the reported average value of 1,815 tons of ore was $49.90 per ton. The ore from the Esmeralda and the Golden Chariot mines was produced by lessees, who milled it in the custom mill of the American Ore Reduction Co. Other important producers were the Queen and the Rex mines.

Jarbidge district.—This district, the deposits of which were discovered in October, 1909, made its first production in 1910, when the output was 127 tons of ore, reported by 6 mine operators. The

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yield of gold and silver in the ore milled, producing gold and silver bullion, and in shipments of small high-grade lots directly to the smelters, was $3,946 in gold and 190 ounces of silver, valued in all at $4,049, at an average value of $31.88 per ton. The country here is rugged and inaccessible, and the lack of roads has restricted development work and the marketing of ores. Freight is taken into the district from Twin Falls and Buhl, in Idaho, stations on the Oregon Short Line Railroad. In the winter months the wagon roads to Jarbidge are impassable.

Railroad district.—The production of 162 tons of ore, from 4 mines in 1910, contained $75 in gold, 3,682 ounces of silver, 8,992 pounds of copper, and 61,769 pounds of lead, having a total value of $5,923, at an average value of $36.56 per ton. All of the ore was of shipping grade, with the exception of a small quantity treated at a milling plant, producing gold and silver bullion. The Elk mine, worked by lessees, produced the largest quantity of copper-lead ores, carrying silver.

Tecoma district.—One property, the Jackson, yielded several important lots of oxidized lead ore, containing some silver, mined by lessees and the owner.

Tuscarora district.—Nearly all of the product shipped from the district consisted of gold and silver bullion and a test lot of ore sent directly to the smelters. The bullion was the result of treatment of 2,600 tons of tailings and 271 tons of crude ore, and contained $13,921 in gold and 8,146 ounces of silver. The Dexter property was worked by lessees, and hydraulic operations were carried on in a small way at the placer diggings.

ESMERALDA COUNTY.

Mine production of gold, silver, copper, and lead in Esmeralda County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	500,265.07	$10,341,397	580,226.10	$11,994,338	79,961.03	$1,652,941
Silver.....do....	134,157	69,762	198,703	107,300	64,546	37,538
Copper.....pounds..	52,184	6,784	122,593	15,569	70,409	8,785
Lead.....do....	88,814	3,819	153,310	6,746	64,496	2,927
Total.....	.....	10,421,762	.....	12,123,953	.....	1,702,191

In 1910 the northern portion of Esmeralda County, embracing the mining regions of Hawthorne, Rawhide, Aurora, Santa Fe, Silver Star, and other districts, was named Mineral County. Under this heading the productions of 1909 and 1910 are compared.

There were 79 deep mines reported from Esmeralda County in 1910, or 40 more than in 1909, and the output of ore, amounting to 523,982 tons, was an increase of 72,067 tons. The total average value per ton increased from $23.06 in 1909 to $23.14 in 1910, and the gold and silver average value increased from $23.04 to $23.09. The largest proportion of the ores, aggregating 509,840 tons, treated principally at mills using concentration, amalgamation, and the

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cyanide process, were dry or siliceous in character, and contained $10,232,199 in gold and 81,678 ounces of silver, a total value of $10,276,305, which gave an average recovery of $20.15 per ton. The practice at the Goldfield Consolidated mill, where the largest tonnage of ore was treated in 1910, is to reduce the ore to slime. The slime is concentrated and the concentrate subjected to amalgamation and then cyanidation. The residues of the sulphide concentrate, although too low in value to ship profitably, were utilized at certain smelters for their sulphur content. In 1910 there were 16,883 tons of residues and concentrates sent to the smelters, containing $530,821 in gold, 45,024 ounces of silver, 78,530 pounds of copper, and 6,188 pounds of lead, valued in all at $565,379, or an average value of $33.50 per ton. The crude ore shipped directly to smelters aggregated 3,863 tons, containing $1,230,827 in gold, 71,979 ounces of silver, 44,063 pounds of copper, and 147,122 pounds of lead, valued in all at $1,281,765, or an average value of $331.81 per ton. Five hundred tons of ore were credited as copper ore, 483 tons as lead ore, and the remainder as dry or siliceous ore. The placer production of the county consisted of $491 in gold and 22 ounces of silver.

Goldfield district.—The table following shows the production of metals and ores in the Goldfield district in 1909 and 1910:

Mine production of gold, silver, and copper in Goldfield district, Esmeralda County, Nev. in 1909 and 1910.

Metal.	1909		1910		Increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	453,915.25	$9,383,261	538,759.63	$11,137,150	84,844.38	$1,753,889
Silver.....do....	33,164	17,245	117,598	63,503	84,434	46,258
Copper.....pounds..	52,015	6,762	107,282	13,625	55,267	6,863
Total.....	.....	9,407,268	.....	11,214,278	.....	1,807,010

The following table shows production of gold and silver in the Goldfield district from the time it became productive up to the end of 1910:

Mine production of gold and silver in Goldfield district, Esmeralda County, Nev., from its inception in 1903 to 1910, inclusive, in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1903.....	3,418.66	$70,670	287	$155	$70,825
1904.....	113,293.23	2,341,979	19,964	11,374	2,353,353
1905.....	91,087.76	1,882,951	8,589	5,188	1,888,139
1906.....	339,890.20	7,026,154	15,648	10,484	7,036,638
1907.....	406,756.16	8,408,396	71,710	47,329	8,455,725
1908.....	236,082.14	4,880,251	30,823	16,336	4,896,587
1909.....	453,915.25	9,383,261	33,164	17,245	9,400,506
1910.....	538,759.63	11,137,150	117,598	63,503	11,200,653
Total.....	2,183,203.03	45,130,812	297,773	171,614	45,302,426

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A very substantial increase of $1,753,889 in gold was made in 1910, due largely to the new milling facilities at the Goldfield Consolidated mine. The increase would have been still greater had not a disastrous fire closed the 100-stamp mill for seven days in April and caused the mill to be operated at a reduced capacity until the middle of July. A large quantity of ore was also milled in 1910 from the Florence mine. These mines were the two greatest producers in the district in 1910. The mill of the Consolidated mine is equipped with 100 stamps, concentration, amalgamation, regrinding, and cyanidation equipment, and is said to be making an average saving of 93 per cent from ores that assay from $30 to $40 per ton. The Florence, with a similar process, is saving 95 per cent from ore assaying from $12 to $20 per ton, and the concentrate is shipped directly to the smelter. At the Consolidated the concentrate is reduced by regrinding, amalgamating, and cyaniding and the residues are shipped to the smelter. At the beginning of milling operations of the Goldfield Consolidated the ore was amalgamated at the batteries and below the tube mills. With increasing depth in the mine, the baseness of the ore rendered this operation unprofitable, and it was abandoned in September, 1909, in favor of amalgamation of the concentrate prior to cyaniding. From the concentrate 20 per cent of the gold is recovered by amalgamation, leaving 52 per cent to be recovered by further treatment of concentrate. The new refinery, started in December, in effect is a small smelting plant and does away with the necessity of shipping the concentrate residue and low-grade bullion. The gold bullion is refined to 900 in fineness.

Forty-four mines produced 339,219 tons of ore. Nearly all this ore, or 336,168 tons, was milled at plants in the district, and yielded bullion containing $9,386,079 in gold and 62,308 ounces of silver, valued in all at $9,419,725, or an average value of $28.02 per ton. In addition, shipments were made aggregating 16,873 tons of concentrate and concentrate residues after cyanide treatment, containing $530,544 in gold, 44,721 ounces of silver, and 78,212 pounds of copper, with a total value of $564,626, or an average value per ton of $33.46. The remainder of the output of the district was crude ore shipped directly to smelters and aggregated 3,051 tons, which contained $1,220,501 in gold, 10,569 ounces of silver, and 29,070 pounds of copper, with a total value of $1,229,900, and an average value per ton of $403.11. In 1909 the total average yield of the total ore output of the district, aggregating 297,199 tons, was $31.65 per ton, and in 1910 the total ore output was 339,219 tons and averaged $33.06 per ton.

According to the annual report for the year ending October 31, 1910, issued for the Goldfield Consolidated mines, 266,687 tons of ore were mined, upon which $10,273,934 was realized, at an average recovery of $38.50 per ton. Dividends were paid covering the same period aggregating $7,118,271. Mining at 1,000 feet in depth in the Consolidated property is said to be developing large bodies of milling ore, with some streaks of rich ore. The Florence Co. has heretofore done little work at a greater depth than 350 feet, and this has been in the way of cleaning up the ground by leasing companies. Now, however, this property is to be opened from 350 to 1,000 feet in depth. According to the annual statement issued by the company for the year ending December 31, 1910, the main shaft has been

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sunk 530 feet and during this period 52,027 tons of ore were mined and milled. The revenue for the year was $586,539, and the one dividend paid to stockholders amounted to $105,000.

Of the smaller properties at Goldfield, the Combination Fraction produced ore in 1910 which was milled at the plant of the Nevada Reduction Works, the heads averaging about $25 per ton. Throughout the year lessees have been steadily developing the Atlanta, C. O. D., Merger, Booth, Oro, Sandstorm, Kendall, Silver Pick, Daisy, Belmont, Black Butte, Spearhead, Simmerone, Blue Bull, and Commonwealth properties. On some of these properties stringers of ore and small ledges have afforded lessees working capital.

Gold Mountain district.—The production of 161 tons of ore from four deep mines contained $3,815 in gold, 6,991 ounces of silver, and 16,087 pounds of lead, valued at $8,298, or an average value of $51.54 per ton. The larger part of this output was shipped directly to smelters. The Commercial, Bonnie Claire, Sunset, and Johnston groups were producers of oxidized ores.

Hornsilver district.—Ten mines in 1910, against four producing in 1909, produced 226 tons of shipping ore, containing $4,936 in gold, 14,768 ounces of silver, and 661 pounds of lead, valued in all at $12,940, at an average value of $57.26 per ton. The Great Western, Connector, Nevada Crane and Sunset, Silver King, and Orleans were producers.

Lida district.—Twelve deep mines and one placer produced 781 tons of ore and treated 1,300 tons of old tailings containing $5,470 in gold, 34,586 ounces of silver, 14,299 pounds of copper, and 101,574 pounds of lead, valued in all at $30,432. The ore and tailings, exclusive of the placer production, averaged $16.82 per ton. The Buster, Storm Cloud, Florida, Smuggler, and Bon Ami were producers.

Lone Mountain district.—The production of 64 tons of shipping ore was made by three operators and contained $149 in gold, 4,997 ounces of silver, and 22,786 pounds of lead, valued in all at $3,850, at an average value of $60.16 per ton.

Montezuma district.—The production of copper ore contained silver and gold, which averaged $53.75 per ton.

Silverpeak district.—The production of 182,527 tons of ore treated includes the treatment of 8,865 tons of old tailings and 18 tons of ore containing lead, shipped directly to the smelters. This production was from four mines, the same number producing in 1909. The yield of bullion and ore shipped contained $842,806 in gold, 19,625 ounces of silver, and 12,202 pounds of lead, valued in all at $853,940, at an average value of $4.68 per ton. The total value of the ores producing the metals in 1909 was $932,847. The largest producer, the Pittsburg-Silverpeak Co., absorbed the Silverpeak-Valcalda and added 20 stamps to the former 100-stamp mill equipped for the cyanide process. Ores at the mine are extracted by steam shovel, glory hole, and underground mining.

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EUREKA COUNTY.

Mine production of gold, silver, copper, and lead in Eureka County, Nev., in 1909 and 1910.

Metal.	1909		1910		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	21,027.26	$434,672	3,942.03	$81,489	17,085.23	$353,183
Silver.....do....	187,710	97,609	36,047	19,466	151,663	78,143
Copper.....pounds..	101,500	13,195	721	91	100,779	13,104
Lead.....do....	4,346,535	186,901	672,801	29,603	3,673,734	157,298
Total.....	.....	732,377	.....	130,649	.....	601,728

Eight reports from deep mines in the county in 1910, against 23 in 1909, showed a yield of 11,977 tons of ore, 76,364 tons less than in 1909. The total average value per ton in 1910 was $10.48, an increase from $8.12 in 1909. The gold and silver value of this ore also increased from $5.86 in 1909 to $8 in 1910. The largest part of the ore produced, aggregating 8,188 tons, was shipped to smelters, yielding $56,788 in gold, 35,796 ounces of silver, 721 pounds of copper, and 672,801 pounds of lead, having a total value of $105,813, and an average value of $12.92 per ton. Mill bullion was produced from 3,789 tons, containing $19,585 in gold and 233 ounces of silver, and averaged $5.20 per ton. The placer production reported by five operators amounted to $5,116 in gold and 18 ounces of silver. The production of the county was seriously reduced by the washing out in February of a part of the roadbed of the Eureka & Palisade Railroad. In December the United States Smelting Co., owning the Richmond-Eureka mines, bought the railroad and expects to put it in operation to serve its mines.

Buckhorn district.—Early in 1910 some discoveries of low-grade ore were made in this new district, which is about 20 miles due west of Alpha, a station on the Eureka & Palisade Railroad south of Palisade. Only one operator reported from the district in 1910 the output of a small lot of ore, which contained gold, silver, and a small quantity of copper.

Eureka district.—Seven operators reported in 1910 the production of 11,923 tons of ore, containing $70,537 in gold, 33,349 ounces of silver, 702 pounds of copper, and 672,801 pounds of lead, valued in all at $118,238, or an average value of $9.92 per ton. The larger part of this production, aggregating 8,134 tons, was shipped to smelters, and contained gold, silver, copper, and lead. The gold and silver bullion produced from 3,789 tons of ore contained $19,585 in gold and 233 ounces of silver. The largest producer, the Windfall mine, was closed in March on account of the partial destruction of the Eureka & Palisade Railroad, and its output of bullion extracted from the ore by cyanidation was much less than in 1909. The property is equipped with a 100-ton mill.

Lynn district.—The output of gold and silver bullion from this district was from five placers and consisted of $5,116 in gold and 18 ounces of silver. The fineness of the gold averaged about 930. In 1909 the yield of bullion contained $14,856 in gold and 85 ounces of silver, produced by six placers. The Golden Doll Fraction, the Com-

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promise No. 10 in Sheep Gulch, and the Bulldog, the Jingo, and the North Star were producers. These placers are worked by drift mining and sluicing and also rocking with cradle and dry washing.

HUMBOLDT COUNTY.

Mine production of gold, silver, copper, and lead in Humboldt County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	18,421.64	$380,809	70,554.26	$1,458,486	52,132.62	$1,077,677
Silver.....do....	80,639	41,932	280,632	151,541	199,993	108,609
Copper.....pounds..	5,477	712	7,182	912	1,705	200
Lead.....do....	60,488	2,691	107,063	4,711	46,575	2,110
Total.....	.....	426,054	.....	1,615,650	.....	1,189,596

The output of gold in Humboldt County was considerably increased by bullion shipments from the new National district, where extremely rich ore was mined in 1910, averaging about 1 ounce of gold to an ounce of silver. The completion of the Western Pacific Railway in 1910 afforded improved transportation facilities to the west-central part of this country. From the reports of 71 producing deep mines in 1910, against 46 reported in 1909, there were produced 6,648 tons of ore, 4,896 tons less than in 1909. The total average value per ton in 1910 was $242.67, as against $36.85 per ton in 1909. The largest part of the average value per ton consisted of gold and silver, which increased from $36.56 in 1909 to $241.83 in 1910. This increase in value per ton was largely attributed to the production in 1910 made by the National mine, which produced notably rich free gold ore. The ore was treated in a small amalgamation mill, and the entire product, consisting of bullion, was shipped to the Government mints and assay offices. The tonnage of ore treated at milling plants using amalgamation and cyanide processes aggregated 6,147 tons, yielding gold and silver bullion, which contained $1,443,232 in gold and 182,974 ounces of silver. Smelting establishments received from this county 484 tons of ore, containing $9,672 in gold, 91,661 ounces of silver, 5,284 pounds of copper, and 101,410 pounds of lead, valued at $64,302, or an average value of $132.85 per ton. There were 75 tons of concentrates produced at these milling plants, which yielded at the smelters $3,284 in gold, 5,927 ounces of silver, 1,898 pounds of copper, and 5,653 pounds of lead, valued at $6,975, or an average value of $93 per ton. The placer production, reported by 5 operators, amounted to $2,298 in gold and 70 ounces of silver.

Antelope district.—The production of 72 tons of shipping ore was reported, which contained principally lead, silver, and some copper and gold, valued in all at $3,526, or an average value of $48.97 per ton. The Antelope Spring and Nevada Superior properties were under development, and the shipments of sulphide and oxidized ore came from that work.

Dun Glen district.—This district, otherwise known as Chafey, yielded in 1910 from its mines 492 tons of ore from 9 mines. This ore contained $10,250 in gold, 1,246 ounces of silver, 32 pounds of copper,

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and 158 pounds of lead, valued in all at $10,934, or an average value of $22.22 per ton. In 1909, 4 mines produced 6,401 tons of ore, valued at $132,273 for the gold and silver content. All of the ore, with the exception of 15 tons, was treated at amalgamation mills in 1910, yielding gold and silver bullion and a small tonnage of concentrate.

Echo district.—One mine in this district yielded ore of shipping grade, which contained small values in gold, silver, copper, and lead, at an average value of $16.83 per ton.

Florence district.—The report received from 1 mine gave a production of gold and silver ore treated at a milling plant, producing bullion having an average value of $32.28 per ton.

Gold Run or Adelaide district.—From 2 mines in 1910 the production was reported of 15 tons of ore, containing $49 in gold, 926 ounces of silver, and 13,233 pounds of lead, valued in all at $1,131, or an average value of $75.40 per ton. All of the ore, with the exception of a small test at a milling plant, was shipped to smelters.

Humboldt district.—From the treatment of 100 tons of ore, which produced gold and silver bullion and some concentrate, containing copper in addition to the gold and silver, an average value of $35.04 per ton was recovered.

Iron Hat district.—One operator reported the production of lead ore, containing silver, which averaged $38.90 per ton.

Imlay district.—The production of 431 tons from 3 mines contained $1,973 in gold, 5,079 ounces of silver, 869 pounds of copper, and 6,433 pounds of lead, valued at $5,109, at an average value of $11.85 per ton. The returns were made for bullion recovered from 425 tons of ore, 64 tons of concentrate, and 6 tons of ore shipped directly to smelters.

Kennedy district.—The St. Patrick mine produced oxidized ore, which contained gold, silver, and lead, shipped directly to the smelters. The property is opened through adits 700 feet, 478 feet, and 465 feet in length.

National district.—This district is situated about 75 miles north of Winnemucca and 8 miles south of the Oregon State line. During nearly all of 1910 the National mine was operated by lessees, and was not taken under company management until October. A mention of the National mine by Cutler [1] gives an idea of the richness and small quantity of ore mined. The high-grade ore, assaying over $20 per pound, was taken out in sacks to the mill, crushed in a small Blake crusher to ½-inch mesh, then recrushed in a small laboratory crusher to ¼-inch mesh. From this crusher it passed to a No. 2 cone grinder, and finally to a Brann disk grinder, where it was pulverized to pass a 60-mesh screen. The pulp was then put into a 4-foot pan arrastre with the proper amount of quicksilver and water and amalgamated for six hours. About 150 pounds of ore were worked to a charge and 4 charges in 24 hours. An extraction of 98 to 99.5 per cent was made and the tailing shipped to the smelter. About $650,000 were turned out by this little mill in less than three months. Besides the high-grade ore, three other grades were made; seconds, assaying from $2 to $6 per pound; high-grade mill ore, $100 to $1,000 per ton; and low-grade mill ore, anything assaying over $8 per ton and too low grade for other classes. The last three grades

[1] Cutler, H. C., National mine: Min. and Sci. Press, Nov. 5, 1910, p. 607.

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were placed in bins or on dumps until such time as other means of reduction could be obtained.

Rebel Creek district.—A small quantity of gold and silver bullion was reported as recovered from 3 tons of ore, which averaged $16 per ton.

Rosebud district.—In 1910 from 6 mines small lots of ore were shipped, aggregating 15 tons, containing $37 in gold and 4,688 ounces of silver, valued in all at $2,569, or an average value of $171.26 per ton. The Durango Girl and the Good News properties were worked.

Seven Thoughts district.—From 27 reports made by owners and lessees of mines in this district in 1910, there was a production of 4,945 tons of ore treated at milling plants using the cyanide process and a small tonnage that was shipped directly to smelters, both containing $184,276 in gold and 192,996 ounces of silver, valued in all at $288,494, or an average value of $58.34 per ton. The average grade of the ore was about the same as in 1909, when it was valued at $59.61 per ton, but the quantity mined and treated was almost double. In 1908 the average yield per ton of gold and silver was $53.14. The Fairview, Mazuma Hills, Therian, Kindergarten, and Wihuja properties were the principal producers of gold and silver ores. Most of the ore is treated at the custom mill of the Darby Mining and Reduction Co. at Mazuma. This mill is operated by gasoline engines and is equipped with crushers, 10 stamps, Deister concentrators, and a Don classifier. The ore passes over 2 series of amalgamation plates, and the tailing is cyanided. During all of 1910 the Fairview claim was operated by lessees. The shaft on the lease is 300 feet deep with a winze sunk an additional 100 feet. The ore sent to the mill is mined from two veins of the Fairview claim, gold predominating in one and silver in the other. The ore from the former contains free gold and some silver; and that from the latter contains tetrahedrite and ruby silver. The gangue consists of quartz and barite. The concentrate is rich in silver, also in copper, derived from the tetrahedrite. The Wihuja, the Therian, and the Kindergarten groups are developed by an incline shaft 575 feet on the latter, 500 feet of which follows the dip of the vein. Another shaft was sunk 340 feet vertically, cutting the Kindergarten vein at 300 feet. Ore is hoisted in nearly equal tonnages daily from the 2 shafts. The ore being mined and milled, though comparatively small in quantity, is said to run about $150 per ton. Small lots of very rich ore have been sacked and shipped. The mill has 10 stamps, amalgamating plates, and concentration tables. The tailings are impounded for future treatment.

Spring Valley district.—Two placers, 1 a dredge, reported a small production of placer bullion, which was largely the output of test runs made by a dredge. Through the operations of the dredge of the Federal placer mine in 1910, the placer output of 1911 promises to be an important one for the district.

Unionville district.—Two mines produced 11 tons of ore in 1910, which was milled and produced bullion, containing $230 in gold and 9 ounces of silver, valued in all at $235, or an average value of $21.36 per ton. The Iduna and Coarse Gold properties were producers.

Warm Springs district.—From the operations of a milling plant was reported gold and silver bullion recovered from 25 tons of ore at an average of $14.96 per ton.

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Winnemucca section.—Nearly all of the 124 tons of ore mined in this section, with the exception of 1 ton milled, was shipped to smelters, and the total tonnage yielded $1,633 in gold, 5,315 ounces of silver, 14,019 pounds of lead, and a small quantity of copper, valued at $5,122, at an average value of $41.31 per ton. For convenience of tabulation, the production of mines at Laurel, Barrett Springs, and Winnemucca Mountain are included in the production of the district.

Yellowstone district.—From the treatment of a trial lot of ore produced by 1 property, a total value of gold and silver bullion of $1,876 was recovered.

LANDER COUNTY.

From 12,484 tons of ore, produced by 16 deep mines and from 10 placers in 1910, there was produced $41,513 in gold, 79,132 ounces of silver, 11,383 pounds of copper, and 81,068 pounds of lead, valued in all at $89,257, or an average value of $6.70 per ton. The tonnage of ore produced was 10,404 tons greater than that produced in 1909, when the total value from 17 deep mines was $35.93 per ton. Both years the average value was largely for gold and silver, which, in 1909, was $34.52 and decreased in 1910 to $6.29 per ton. Of the ore produced, 697 tons were shipped directly to the smelters. A large quantity of old tailings was treated and the content was included in the bullion reported at gold and silver mills. Ten placer operators reported a production of $5,627 in gold and 46 ounces of silver in 1910.

Reese River district.—The production of 6 mines, situated at Austin, aggregated 674 tons of ore, which yielded $3,764 in gold, 27,159 ounces of silver, 6,797 pounds of copper, and 72,076 pounds of lead, valued in all at $22,464, or an average value of $33.33 per ton. The larger part of this ore was concentrated, yielding a product containing gold, silver, and lead. The most valuable part of the output was contained in 206 tons of ore shipped directly to smelters, which contained 66.71 ounces of gold, 19,463 ounces of silver, 6,797 pounds of copper, and 70,186 pounds of lead. In 1909 the total value of the ore produced, containing the same metals, was $9,074. The Jackpot and the Frost mines yielded the principal part of the district output. Sulphide ore, with a high siliceous gangue and a small percentage of lead, was mined. The oxidized ores extend to a depth of about 75 feet. Several shafts, the deepest 950 feet, and a tunnel 6,000 feet long, open up these old mines. A concentrating plant, using the Huff electrostatic separators, was put in operation in October. It is said that this is the first attempt to treat crude ores by the Huff method in the United States.

Battle Mountain and Bannock districts.—The yield of ore in 1910 was made by 2 mines, which produced 28 tons of ore, containing $888 in gold and 120 ounces of silver, both valued at $953, or an average value of $34.04 per ton. According to the reports made by 10 placer operators, $5,627 in gold and 46 ounces of silver were produced. Most of the placering was carried on at Bannock, a new camp, 16 miles southwest of Battle Mountain, established late in the summer of 1909. Nuggets of gold, ranging from 3.5 ounces to coarse shot gold having an average fineness of about 856, were found in drift mining and dry washing. Quartz mining developments in the vicinity of this camp are promising and the finding of large nuggets of gold encourages further prospecting.

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Dean or Lewis district.—Bullion containing gold and silver was produced from ore mined from the Independence claim.

Galena district.—The reports received from 3 mines show the production from 11,717 tons of old tailings and ore of $26,704 in gold, 51,574 ounces of silver, 4,558 pounds of copper, and 8,804 pounds of lead, valued in all at $55,520, or an average value of $4.74 per ton. The low average value is accounted for by the treatment of a large tonnage of old tailings, which produced gold and silver bullion. The lead and copper were contained in 412 tons of ore shipped directly to smelters. The Iron Canyon and the Tenabo properties produced most of the ore.

Hilltop district.—From 3 properties the production was reported of 52 tons of ore, containing $4,353 in gold, 230 ounces of silver, 28 pounds of copper, and 188 pounds of lead, with a total value of $4,489, or an average value of $86.33 per ton. All of the ore, with the exception of 1 ton, which was milled and produced bullion, was shipped to smelters. The Pittsburg Red Top and the Philadelphia Western were producers.

Jackson district.—One operator reported the production of gold and silver ore, which produced bullion and averaged $13.67 per ton.

LINCOLN COUNTY.

Mine production of gold, silver, copper, and lead in Lincoln County, Nev., in 1909 and 1910.

Metal.	1909		1910		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	16,127.45	$333,384	1,687.13	$34,876	14,440.32	$298,508
Silver.....do....	224,852	116,923	54,571	28,468	170,281	87,455
Copper.....pounds..	173,446	22,548	7,653	972	165,793	21,576
Lead.....do....	1,495,628	64,312	935,255	41,151	560,373	23,161
Total.....	.....	537,167	.....	106,467	.....	430,700

The yield of 4,310 tons of ore from 18 deep mines in 1910 was 99,875 tons less than was produced from 17 mines in 1909. The total average value of the ore increased from $5.16 per ton in 1909 to $24.70 in 1910, and the gold and silver value in this ore increased from $4.32 to $14.93 per ton. The larger part of the tonnage was of shipping grade, aggregating 3,543 tons, which contained $18,597 in gold, 49,577 ounces of silver, 7,653 pounds of copper, and 913,511 pounds of lead, valued in all at $86,535, or an average value of $24.42 per ton. Gold and silver bullion, containing $16,175 in gold and 4,606 ounces of silver, was produced from 592 tons of ore. The bullion includes that produced from cleaning up the old Delamar mill in the Ferguson district. Some ore was concentrated, producing 43 tons of concentrate, which contained gold, silver, and lead, and averaged $29.56 per ton. The greatly reduced yield of the county was caused by the floods sweeping away the tracks of the San Pedro, Los Angeles & Salt Lake Railroad, which operated a spur to the Pioche district. The mines were practically prevented from making a production the first half of 1910.

Ferguson or Delamar district.—Reports received from Delamar furnished the information concerning the permanent closing of the old

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Bamberger-Delamar mines in 1909, and the output reported for 1910 was that of lessees shipping residues resulting from the burning of the woodwork from the precipitating department of the Delamar mill, which yielded considerable gold.

Eagle Valley district.—Seven mines yielded 593 tons of ore, containing $3,288 in gold and 3,968 ounces of silver, valued at $5,430, at an average value of $9.16 per ton. In 1909 the operators of mines at Fay produced 782 tons of ore, yielding gold and silver. Nearly all the ore was treated at milling plants, producing bullion.

Pioche district.—In 1910, 10 mines yielded 3,692 tons of ore, containing $18,663 in gold, 49,057 ounces of silver, 7,653 pounds of copper, and 935,255 pounds of lead, valued at $87,277, at an average value of $23.64 per ton. All of this ore was of shipping grade and includes 43 tons of concentrate, which contained principally lead, silver, and gold, as the result of the treatment of some old tailings. The production of 1910 was not as great as in 1909 (when 14,055 tons were produced), on account of the floods causing the closing of the railroad line operating between Caliente and Pioche. Among the large producers were the Day and Jack Rabbit and the Mendha, Demijohn, Prince, Highland Mary, and Pioche Metals mines.

LYON COUNTY.

The mines about Silver City and Dayton continued to furnish nearly the entire metallic production of Lyon County, principally in gold values. In the Mason Valley or Yerington district considerable development work was centered in the completion of the Nevada Copper Belt Railroad, from Wabuska, on the Southern Pacific, to Yerington and Mason, and also in the erection of a new smelter at Thompson, near Wabuska. The production of 11,117 tons of ore, made by 28 operators in 1910, was 7,434 tons less than was made by 19 operators in 1909. The total average value per ton, which was $6.24 in 1909, increased to $11.11 in 1910, production of both years being gold and silver only. Only one placer operator reported production. Ore treated at milling plants using cyanide and amalgamation processes yielded $110,380 in gold and 10,183 ounces of silver, which was produced from 10,984 tons of ore, averaging $10.55 per ton. Some of the mills were equipped with concentration devices and produced in all 122 tons of concentrate, containing $7,169 in gold and 338 ounces of silver, having a total value of $7,352, and an average value of $60.26 per ton. Only 3 tons of gold-silver ore were shipped from the county directly to smelters.

Mason Valley district.—The copper mine operators near Mason and Yerington were actively engaged in developing properties during 1910. The Copper Belt Railroad was completed from Wabuska through Mason to within a short distance of the Douglas mines. It is expected that the smelter near Wabuska, for the treatment of the copper ores, will be completed in November, 1911.

Ramsey district.—The Ramsey Comstock mine yielded ore in 1910 containing principally gold with a little silver. Both bullion and concentrate were shipped. The property was closed late in the year.

Silver City district.—The mines in the vicinity of Silver City and near Dayton produced, according to the reports of 26 operators, 7,114 tons of ore, containing $79,120 in gold and 10,443 ounces of

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silver, valued at $84,759, at an average value of $11.91 per ton. In addition to this output, King's placer in Gold Canyon yielded some bullion, which was taken out by drift mining and sluicing. The largest deep mine producers were the Ida, Snell, Santiago, and Carson mines.

MINERAL COUNTY.

Mineral County is a new county, including mines that were in Esmeralda County in 1909. The mine output of 18,743 tons of ore for 1910, produced by 68 operators, was 1,955 tons less than the output made by 39 mine operators in the same districts in 1909. From 18,743 tons of ore there were produced $171,737 in gold, 522,520 ounces of silver, 47,375 pounds of copper, and 711,517 pounds of lead, having a total value of $491,222, and an average value of $26.21 per ton, the larger part of which was for the gold and silver content, which was valued at $24.22 per ton. In 1909 the total average value was $51.28 per ton, and the gold and silver value was $46.83 per ton. The larger part of the ore, aggregating 15,948 tons, was dry or siliceous in character. The quantity of lead ore produced was 2,777 tons, and that of copper ore 18 tons. The placer output made by 8 operators aggregated $11,985 in gold and 467 ounces of silver. Comparing this yield with the combined output of the productive districts forming the northern part of Esmeralda County in 1909, decreases are to be noted in output of silver and lead. Mines in the Rawhide district were responsible for the increase of $3,257 in gold. Copper produced from other districts also shows a slight increase. The total value of all the metals produced in 1910, compared with that of 1909, decreased $357,517. The larger part of this decrease is for the silver and lead, caused by the decrease in the output of the mines near Hawthorne.

Aurora district.—Operators of the Cain property reported the production of gold and silver recovered from ores and tailings yielding bullion at its milling plant.

Bovard district.—Four properties produced shipments aggregating 12 tons, containing $1,547 in gold and 317 ounces of silver, both valued at $1,718, or an average value of $143.16 per ton.

Columbus district.—From one mine in the district was reported a yield of gold and silver ore, averaging in value $21.78 per ton.

Gold Range district.—Ore containing gold and silver was produced from the Oriole mine and treated in a milling plant in the vicinity.

Hawthorne section.—This section includes the Lucky Boy and he Palmico districts. Two-thirds of the ore produced by mine operators was shipped to smelters and aggregated 2,683 tons, containing 114.51 ounces of gold, 420,098 ounces of silver, 42,966 pounds of copper, and 671,860 pounds of lead. There were also treated at milling plants 1,407 tons of ore, yielding bullion containing $14,560 in gold, and 1,286 ounces of silver. The product mined by 15 operators, including 1 ton of concentrate containing gold, was valued at $280,427, or an average value of $68.56 per ton. The Mountain King claim, at Lucky Boy, yielded from the operations of lessees an important tonnage of lead sulphides carrying almost an ounce of silver to each pound of lead contained in the ore. The mine is opened by an inclined shaft at a vertical depth of 600 feet. A concentration plant equipped with 10 stamps and Pinder tables was completed the latter

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part of 1910, but the delay in getting electric power from Mono, Cal., delayed operations of the mill. The year's production of this property was said to have been decreased on this account. Some work was performed on the Durand claim by a lessee. The Palmico and the La Panta mines are opened by an adit 560 feet long. A concentration mill equipped with 20 stamps and tables was operated part of the year on gold and silver taken out in development of the mines.

Klondyke district.—The yield made by 2 mines of shipping grade ore averaged in value for its silver, lead, and gold content $45.63 per ton.

Pine Grove district.—From 6 mines was reported the yield of 273 tons of ore, which produced gold and silver bullion containing $3,246 in gold and 2,817 ounces of silver, valued together at $4,767, or an average value of $17.46 per ton.

Rawhide district.—Mines in this district yielded 12,582 tons of ore, produced by 22 operators and containing $135,158 in gold and 78,117 ounces of silver. A small shipment of ore was made from the region containing a small quantity of copper and lead. The total output was valued at $177,395, or an average value of $14.10 per ton. In 1909 the value of the gold and silver content of 6,197 tons of ore was $202,715, with an average recovery of $32.71 per ton. From 1,826 tons in 1908 the average yield was $80.61 per ton. The surface work by dry placering in 1910 produced, according to reports of 5 operators, $11,985 in gold and 467 ounces of silver. The two largest holding companies in this district, the Rawhide Coalition and the Rawhide Queen, were merged in August, thus making one more large operating unit among the mines of Nevada. The mills and mines were in operation the entire year. A 60-ton cyanide plant was in course of construction the latter part of the year. The greatest depth attained on either property is 560 feet, to which depth oxidized ores extend. The little sulphide ore that has been found has been milled, and the concentrate, containing gold and silver, was shipped to the smelter.

Santa Fe district.—Most of the ore produced in the district in 1910, aggregating 1,011 tons, was treated at milling plants and yielded gold and silver bullion and concentrate, containing gold, silver, and a little copper. There were also produced 109 tons of ore shipped directly to smelters. The total output was mined by 8 operators and contained $3,124 in gold, 10,022 ounces of silver, 3,521 pounds of copper, and 23,288 pounds of lead, valued in all at $10,008, or an average value of $8.93 per ton. In 1909 operators of 10 mines produced 409 tons of ore, yielding the same metals, which had a total value of $20,724. The Julia claim of the Silver State group was operated, and ore containing gold, silver, and lead was treated in a 20-ton Lane mill equipped for amalgamation and concentration. Several properties near Luning and Mina were also productive.

Silver Star district.—Ore produced from 7 mines aggregated 250 tons and contained $4,302 in gold, 7,669 ounces of silver, 536 pounds of copper, and 15,427 pounds of lead, valued in all at $9,191, or an average value of $36.76 per ton. The larger part of the ore, aggregating 174 tons, was treated at milling plants, yielding gold and silver bullion, and 76 tons were shipped directly to smelters.

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NYE COUNTY.

Mine production of gold, silver, copper, and lead in Nye County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	142,509.95	$2,945,942	177,147.65	$3,661,967	+ 34,637.70	+ $716,025
Silver.....do....	8,246,496	4,288,178	10,550,303	5,697,163	+ 2,303,807	+1,408,985
Copper.....pounds..	13,261	1,724	2,038	259	− 11,223	− 1,465
Lead.....do....	95,675	4,114	15,019	661	− 80,656	− 3,453
Total.....	.....	7,239,958	.....	9,360,050	.....	+2,120,092

Production was reported from 95 mines in 1910, against 59 in 1909. The yield of ore aggregated 524,576 tons, which was 98,155 tons greater than in 1909, and the total average value per ton increased from $16.83 in 1909 to $17.58 in 1910. Most of this value was for gold and silver content, which increased in value from $16.82 to $17.56. The deep mines yielded $3,526,326 in gold, 10,547,304 ounces of silver, 2,038 pounds of copper, and 15,019 pounds of lead, valued in all at $9,222,790. The placer output, reported by 37 operators, contained $135,641 in gold and 2,999 ounces of silver. Of the 95 mines, 86 produced gold and silver only; 3, gold, silver, copper, and lead; 1, gold, silver, and lead; 1, gold, copper, and lead; 1, silver and lead; and 3, gold only. Of the placers, 30 were dry washing and sluicing, and 7 drift-mining and sluicing. Nearly the entire tonnage produced was from dry or siliceous ore, only 20 tons being classified as lead ore and 8 tons as copper-lead ore. The larger part of the ore produced was treated at milling plants using the cyanide process and aggregated 477,223 tons, which yielded bullion containing $2,563,087 in gold and 5,956,338 ounces of silver, with a total value of $5,779,510 and an average value of $12.11 per ton. Some of the ores yielded concentrate, which aggregated 3,348 tons, containing $347,216 in gold, 2,176,100 ounces of silver, 913 pounds of copper, and 4,357 pounds of lead, valued in all at $1,522,618, with an average value of $454.78 per ton. Crude ore shipped directly to the smelters aggregated 47,353 tons, containing $616,024 in gold, 2,414,866 ounces of silver, 1,125 pounds of copper, and 10,662 pounds of lead, having a total value of $1,920,664, and an average value of $40.56 per ton.

Bullfrog district.—Nearly the same tonnage of ore produced from 9 mines in 1909 was reported from 18 mines in 1910, yielding in both years gold and silver and a few pounds of copper and lead. The total value in 1910 was but half of that reported in 1909. The district yield in 1910 from 72,594 tons of ore was $416,891 in gold, 94,260 ounces of silver, 171 pounds of copper, and 3,082 pounds of lead, valued at $467,949, at an average value of $6.45 per ton. Almost the entire tonnage, or 71,301 tons, was treated at milling plants using the cyanide process, and 1,293 tons, containing the copper and lead, 3,290.59 ounces of gold and 1,792 ounces of silver, were shipped directly to smelters. The Montgomery-Shoshone mine was the largest producer of mill ore treated by the cyanide process. The grade of the ore was so low in gold and silver that it barely met the cost of mining, milling, and other expenses. The company operating the mine practically ceased work the latter part of 1910. Other properties produc-

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ing were the Diamond Queen, Mayflower, Pioneer, National Bank, Bullfrog Annex, Diamond Bullfrog, Gibralter, Tramp, Eclipse, Denver, and Hobo. Many of these mines were worked by lessees.

Cactus Range district.—From 2 mines in 1910 shipment was reported of a small tonnage of ore, containing gold and silver, which averaged $50 per ton.

Cloverdale district.—A small production made from one of the mines in this district in 1910 yielded gold, silver, copper, and lead.

Ellendale district.—There were produced from 26 tons of ore, shipped from the district in 1910, $18,349 in gold and 718 ounces of silver, valued in all at $18,737, or an average value of $720.65 per ton.

Goldyke district.—Two properties were reported as yielding gold and silver ore valued at $717, or an average value of $71.70 per ton. The production in 1909 consisted of 120 tons valued at $6,498.

Johnnie district.—All of the ore reported from 2 mines in 1910 was treated at milling plants, and produced gold and silver bullion, which contained $100,570 in gold and 696 ounces of silver, which was practically the same yield as in 1909. The Johnnie mine is opened by an incline shaft 900 feet deep. It was the largest producer of oxidized ore, which was reported found in the lowest workings. A plant equipped with 16 Nissen stamps and a 10-foot Lane Chili mill was operated the entire year.

Lodi district.—Gold and silver ore was shipped directly to the smelters, from 2 mines In addition, there was a trial lot of ore treated at a milling plant, producing gold bullion. The total value of the production aggregated $1,135. In 1909 ore was shipped which, in addition to the gold and silver, contained lead and had a combined value of $35,772.

Manhattan district.—Sixty operators of mining properties, including owners and lessees of deep mines and placers, reported a production of $361,602 in gold and 8,071 ounces of silver, with a total value of $365,960. According to reports received in 1909, the total value of the metals produced was $124,942. In 1910 from 31 quartz mines the production was reported of 14,671 tons of ore, yielding $262,958 in gold and 6,113 ounces of silver, valued in all at $266,259, or an average recovery of $18.15 per ton. This average compared very favorably with the average in 1909, when 13 mines yielded 4,198 tons of ore, containing in gold and silver an average value of $18.48 per ton. Another increase was recorded in the placer production over the two previous years, and was reported by 29 operators, who produced $98,644 in gold and 1,958 ounces of silver, valued at $99,701. This was a little more than twice as much gold and silver as was produced in 1909 and more than three times the production in 1908. This district was opened during 1906 in the boom period of the Nevada excitement, and until recently suffered from a lot of unscrupulous promoters who sold stock instead of mining. In the last two years the more serious phase of mining has taken place, and several mines have become large producers in the hands of lessees who have ample milling facilities for custom work. The ores are practically free milling, except in the Consolidated mines eastward, where base ores of high value are said to have been developed. Best results in the treatment of the oxidized ores have been in sliming and cyaniding. The discovery of an extensive productive ore body in the Big Four

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mine has encouraged greater development generally, particularly on Gold Hill. In the Dexter property developments have been carried on by an incline shaft 505 feet in depth and by another shaft 275 feet deep. The Earl mine is opened by a shaft 250 feet. These properties produced in 1910, and also the Golden Gate, Jumping Jack, Little Gray, Litigation Hill Merger, Thanksgiving, Durant, and Giant properties. According to the reports received from placer producers, the yield in 1910 was valued at $99,701, against a total yield of $47,344 in 1909. The output reported for 1909 is considered $20,000 too low, according to authentic information received in 1910. It has been difficult to learn actual production, as some of the original companies lost their holdings. Since then many relocations have been made by individuals who are working or leasing the ground, and a little indifference is shown by some operators in making reports to the Survey. The Golden Gate and the Verde surface placers of erosion material were worked in 1910, and 14 other placers were worked by drift mining, the shafts varying from 35 to 75 feet deep.

The early history of the discovery of placer gold is a trifle vague, but the facts are about as follows: The Dexter Co. in the fall of 1905 found colors in sinking a well for water in the gulch in the lower part of the town, but paid no attention to it. In the summer of 1906 nuggets were discovered at the surface on a bench above the gulch, on the Little Grey claim, opposite shaft No. 12, by a miner named Burns. Throughout that summer and to the present time this bench channel has been worked in a southeasterly direction. The dirt is wheeled in barrows to sluice boxes and washed with water pumped from a well in the gulch.

In April, 1908, when mining in this camp was practically at a standstill, William McDonald, a placer miner from California, believing the gulch would pay, secured a lease on the Nellie Gray and sank shaft No. 13. He reached bedrock in 23 feet, finding pay gravel 5 to 7 feet thick, which averaged $10 per yard, and cleared several thousand dollars before his lease expired.

In 1905 a well had been sunk 45 feet to bedrock at Central, and gold had been found in the gravel, but the circumstance was overlooked in the rush for lode claims. However, the owners at Central, Auxier, Hayward & Crews, on the strength of McDonald's find, put down shaft No. 35 to bedrock, finding 3 feet of rich gravel. The sinking of this shaft and proving the gravel at Central was the real inception of gulch mining in Manhattan.

Thomas Wilson, familiarly known as "Dry Wash" Wilson from his successful placer work at Round Mountain, immediately acquired and completed shaft No. 24, dropping into a wet channel that produced ample water and the largest nuggets found to date, ranging from 5 to 30 pennyweight. From this time in March until the present date, May 24, there have been over 60 shafts sunk to bedrock, varying from 35 to 90 feet, the latter being at shaft No. 63, the farthest west. Nearly all of these shafts have shown pay gravel from 2 to 4 feet thick running from $5 to $30 per yard.

About 25 per cent of the pay gravel consists of subangular bowlders of limestone, quartz, and quartzite, rarely exceeding 1½ cubic feet in size, and generally of a convenient size to handle by one man; the other 75 per cent is made up of sand, gravel, and flat pieces of shale and limestone. Above the pay gravel is usually a foot or two of fine micaceous siltlike mud from the erosion of the schists; the balance to surface is made up of flat pieces of shale, limestone, and lime dust. The gravel stands so well that in sinking the prospect shafts the only timber used is a crib of two or three hewed poles as a collar to support the windlass. Two men, one on the windlass, can sink a 4 by 6 foot shaft, on an average of 8 feet per day, down to 40 feet.

The gold is coarse, very few particles weighing less than half a grain, and from that up to several pennyweight, with occasional large nuggets; it is generally flat in shape and only partially rounded. In fineness it approximates 770, the balance being silver, and averages $15 per ounce. From washings and pannings made by myself of measured amounts, I consider it is safe to say that $10 per cubic yard is a fair estimate, judging from the work done to this date in the gulch. This is confirmed from other reliable sources, and by careful inquiry among the banks handling the bulk of the gold I find that at this date, with the crude apparatus being used, in excess of $1,000 per day were being produced during May, 1909.[1]

[1] Jones, Charles Colcock, Notes on Manhattan Placers: Eng. and Min. Jour., uly 17 1909, pp. 103. 104.

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Millett district.—A small production made from 1 deep mine and 1 placer aggregated $695 in gold and 16 ounces of silver.

Red Springs district.—One operator shipped ore yielding gold and silver, which averaged $31.57 per ton.

Reveille district.—One operator in 1910 shipped a test lot of ore containing silver and lead, which averaged $146 per ton.

Round Mountain district.—From 11 quartz mines, the same number as in 1909, was reported the production of 47,584 tons of ore, which yielded $392,098 in gold and 11,477 ounces of silver, valued in all at $398,296, or an average recovery of $8.37 per ton. In 1909 ore aggregating 41,838 tons yielded gold and silver valued at $494,331, with an average recovery of $11.82 per ton. A small tonnage of gold and silver ore was shipped directly to the smelters, but, as in former years, practically all the product was in the form of mill bullion. In 1910 the placers yielded $36,026 in gold and 1,026 ounces of silver, valued in all at $36,580. This was an increase in production over that made in 1909, when $14,071 was the total value of the gold and silver recovered from placers. The Round Mountain Mining Co. operated a 100-ton amalgamation mill and developed its Sunnyside, Los Gazabo, Great Western Extension, and Combination groups. According to the annual statement of the company for the year ending February 28, 1911, there were 36,252 tons of gold and silver ore treated, valued at $337,682, at an average value of $9.31 per ton, from which a recovery was made of $302,680, or an average of $8.34 per ton. The tailings showed an average loss of 96 cents per ton. The mines are opened by an incline shaft 900 feet deep. Other important properties worked were the Fairview, the Blue Jacket, and the Daisy.

San Antonio district.—The production of shipping ore made by 1 property contained silver and a little gold, and averaged $88.50 per ton.

Silver Bow district.—From 2 properties was reported the production of 9 tons of gold and silver ore, which averaged $94.33 per ton.

Tonopah district.—The following table shows the production in Tonopah district in 1909 and 1910:

Mine production of gold, silver, copper, and lead in Tonopah district, Nye County, Nev. in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	67,742.46	$1,400,361	111,441.58	$2,303,702	+43,669.12	+ $903,341
Silver.....do....	7,872,967	4,093,943	10,422,869	5,628,349	+2,549,902	+1,534,406
Copper.....pounds..	1,784	232	942	120	− 842	− 112
Lead.....do....	1,488	64	6,902	304	+ 5,414	+ 240
Total.....	.....	5,494,600	.....	7,932,475	.....	+2,437,875

The ore production reported by operators of 18 mines in 1910 aggregated 365,139 tons, with a combined metal yield of $7,932,475, or an average recovery of $21.72 per ton. This was an important increase compared with the output in 1909 of 278,743 tons of ore, with a combined metal yield of $5,494,600, or an average value of $19.71 per

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ton. Of the output of 1910, 45,972 tons were shipped to smelters and contained $525,246 in gold, 2,406,713 ounces of silver, 942 pounds of copper, and 6,902 pounds of lead, valued in all at $1,825,095, or an average value of $39.70 per ton. The ore treated at milling plants, principally by the cyanide process, aggregated 319,167 tons, with a yield of bullion containing $1,432,637 in gold and 5,844,767 ounces of silver, both valued at $4,588,811, or an average value of $14.38 per ton. In addition to this bullion, there were 3,310 tons of concentrate produced, yielding 16,728.97 ounces of gold and 2,171,389 ounces of silver, both valued at $1,518,368, or an average value of $458.72 per ton.

The following table shows the gold and silver production from the Tonopah district from 1902 to 1910, inclusive:

Mine production of gold and silver in Tonopah district, Nye County, Nev., from 1902 to 1910, inclusive, in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1902	26,462.58	$547,030	2,434,453	$1,217,241	$1,764,271
1903	25,297.61	522,948	2,404,180	1,274,215	1,797,163
1904	18,703.03	386,626	2,115,191	1,205,659	1,592,285
1905	58,356.99	1,206,346	5,309,429	3,243,141	4,449,487
1906	63,113.75	1,304,677	5,097,923	3,817,612	5,122,289
1907	57,250.36	1,183,470	5,330,398	3,518,063	4,701,533
1908	78,584.75	1,624,491	7,172,396	3,801,370	5,425,861
1909	67,742.46	1,400,361	7,872,967	4,093,943	5,494,304
1910	111,441.58	2,303,702	10,422,869	5,628,349	7,932,051
Total	506,953.11	10,479,651	48,819,821	27,799,593	38,279,244

The milling plants of the Tonopah mine and the Belmont mine are situated at Millers, 14 miles west of Tonopah camp, and those of the Montana-Tonopah and Tonopah Extension are at the mines. All of these mills use the concentration and cyanide processes in the treatment of gold and silver ore, making an average extraction of more than 90 per cent, of which about 35 per cent is due to concentration and about 55 per cent to cyanidation. It is a question whether an all-cyanide treatment would not be more economical, considering costs of producing and marketing the concentrate. It is reported that this method will be tried at one of the mills during 1911.

According to the annual statement of the Tonopah Mining Co. for the fiscal year ending February 8, 1911, during the year there were milled and treated 177,745 dry tons of ore, averaging 0.320 ounce gold and 28.65 ounces silver, or $21.98 in value per ton, which was 0.007 ounce of gold and 0.62 ounce silver, or $1.05 per ton higher than the average of the ore milled during 1909, when silver averaged in value $0.021 per ounce lower. The total contents of the ore milled were 56,800 ounces of gold and 5,092,884 ounces of silver, with a gross value of $3,911,422, from which there were recovered by concentration and shipped to the smelter 1,361 dry tons of concentrates, averaging 5.539 ounces gold and 803.99 ounces silver per ton, with a total content of 7,537.65 ounces of gold and 1,094,269 ounces of silver, and a gross value of $704,928. The entire cyanide treatment yielded in bullion 3,775,547.45 troy ounces, containing 43,530.28 fine ounces of gold and 3,602,242 fine ounces of silver, with a smelter gross value of $2,836,070. The slag and refinery by-prod-

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ucts shipped to the smelter amounted to 101 dry tons, averaging 0.828 ounce of gold and 61.59 ounces of silver per ton, with a total content of 84.13 ounces of gold and 6,255 ounces of silver, of a gross value of $4,868.

The Belmont mine was the second largest producer of the district in 1910. It is developed by 2 vertical shafts, 1,100 feet and 1,300 feet deep. Its cyanide mill, where the low-grade ores are treated, is equipped with 60 stamps; the high-grade ore is shipped direct to the smelter.

Ranking third in production was the Montana-Tonopah mine, ore of which is treated in its 40-stamp mill, producing bullion and concentrate. The Tonopah Extension was the next important producer, the ore of which is treated in its 30-stamp mill, producing bullion and concentrate. Other mines producing were the Butler, MacNamara, Midway, and West End, each one producing high-grade ore which is shipped direct to the smelter.

In 1910 Mr. J. E. Spurr made a careful examination of the Montana-Tonopah and other properties in the camp at the request of the mine operators, and a synopsis of final general results as published by the Montana–Tonopah Mining Co. follows:

At Tonopah the oldest rock is a trachyte flow highly altered to quartz, sericite, and adularia. The lower part of this flow is a fine flow-banded glassy trachyte. The main body of the trachyte contains the oldest and by far the most important group of mineral veins; the glassy trachyte appears practically barren.

Stresses subsequent to the trachytic extrusion produced horizontal faulting near the zone of transition between the main body of trachyte and its glassy lower portion; and along here a glassy trachy-alaskitic intrusion, very full of inclusions, took place. Subsequent movement reopened this line of weakness, and a second trachy-alaskitic intrusion came in—the West End rhyolite sheet. At a subsequent epoch came an eruption of andesite (Midway andesite), largely as a surface flow, but largely also as an intrusive sheet along the old zone of weakness, but typically below the West End rhyolite sheet; at a still later epoch there was a series of rhyolitic and alaskitic surface flows and intrusions, of which the most important in the mine workings is a great intrusive mass called the Tonopah rhyolite.

The principal veins were formed after the trachyte eruption and before the Montana Breccia–West End rhyolite intrusions. They are quartz veins carrying gold and silver. A second set of veins was formed after the West End rhyolite intrusion and before the Midway andesite eruption. This second set is divided into four successive groups—A, large typically barren quartz veins; B, tungsten-bearing veins; C, mixed quartz and adularia veins, typically barren; D, small productive veins like those of the first set, following the trachyte. A third set of veins was formed after the Tonopah rhyolite intrusion. They are quartz veins containing occasional lead, zinc, and copper sulphides.

All of these veins formed at shallow depths, and the different types represent various stages of temperature. The First Period veins represent the normal shallow-seated type, and followed the trachyte eruption; the Second Period B veins represent an abnormally intense shortly sustained temperature, following the trachy-alaskitic intrusion; the Second Period D veins a directly subsequent briefly sustained stage of temperature more normal to shallow depths; the Third Period a relatively high but briefly sustained temperature, following the alaskitic (Tonopah rhyolite) intrusion. No vein formation followed the andesite eruption.

The history of faulting is long and complex; important movements have taken place at every stage of the geologic history. These movements accompanied and were due to the volcanic paroxysms; and were so intense that locally the rocks are ground almost to a powder.

Union district.—From the operation of the Berlin mine, ore containing gold, silver, lead, and a little copper, treated at its 30-stamp mill and yielding gold and silver bullion and concentrate, was taken out by lessees. At Marble, west of the Union district, a new lead furnace has been put up, but was not working satisfactorily at the close of the year. No production was recorded.

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ORMSBY COUNTY.

In the Eagle Valley district the shipment of bullion from one mine was reported, the result of a small test at an amalgamation mill. The operators of mines in the Delaware district did not ship in 1910, but are holding the copper ores mined for shipment to smelting plants under construction nearer the mines than Salt Lake City, to which point ore was shipped in 1909. The Western Smelter Corporation is building a copper smelter on Carson River within 3 miles of Mound House on the line of the Virginia & Truckee Railway. The smelter site is 6 miles distant from Carson City and 15 miles from Virginia City, in Storey County. The plant is being equipped with one blast furnace with a daily capacity of 250 tons for the treatment of copper ores.

STOREY COUNTY.

Mine production of gold, silver, copper, and lead in Storey County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	26,926.54	$556,621	24,325.03	$502,843	−2,601.51	−$53,778
Silver.....do....	501,625	260,845	320,716	173,187	− 180,909	− 87,658
Copper.....pounds..	.....	.....	573	73	+ 573	+ 73
Lead.....do....	1,861	80	1,871	82	+ 10	+ 2
Total.....	.....	817,546	.....	676,185	.....	−141,361

The production of 108,592 tons of dry or siliceous ore was made by operators of 26 mines for 1910 and was 16,500 tons greater than was reported from 22 mines in 1909. The total average value per ton decreased from $8.88 in 1909 to $6.23 in 1910. These average values for both years were for gold and silver. Of the deep mines reported, 24 were for gold and silver; 1 for gold, silver, copper, and lead; and 1 for gold only. The greater part of the tonnage was treated at milling plants using the cyanide process, where 48,722 tons of old tailing and 59,826 tons of crude ore yielded $233,924 in gold and 162,340 ounces of silver, valued in all at $321,588. Some of the mills were equipped with concentration devices, and from this source 1,229 tons of concentrate were produced, yielding $256,338 in gold, 150,384 ounces of silver, 573 pounds of copper, and 1,871 pounds of lead, valued at $337,700, at an average value of $274.77 per ton. Only 44 tons of ore were shipped directly to smelters and yielded $12,581 in gold and 7,992 ounces of silver, both having a total value of $16,897, or an average value of $384.02 per ton. The production of the county was practically that made by mines located on the Comstock Lode. The total average value of $6.23 per ton of the ores in 1910 is a decided decrease from the total produced, aggregating 92,092 tons in 1909, when the total average value was $8.88 per ton. The Ophir mine continued to be the largest producer of the Comstock district. According to a published statement for the year ending November 30, 1910, there were 9,410 tons of ore concentrated in the Kinkhead mill, containing $151,401 in gold and

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$59,049 in silver, a total value of $210,451, or an average value of $22.36 per ton. There were also sold 1,637 tons of ore, averaging in gold and silver $24.65 per ton. The principal mine operations of 1910 were on the five levels from the 2,000-foot to the 2,400-foot level, inclusive. Another year of activity in the production of bullion and concentrate containing gold and silver was made by the Charles Butters Co. (Ltd.) from the Chollar and Potosi mines. The third largest yield was from the famous Consolidated-Virginia, which was worked through the C. & C. shaft 2,650 feet deep. The ore produced was concentrated at the Kinkhead mill and yielded some bullion. Although the Mexican mine [1] has the deepest workings on the Comstock Lode, it has never produced enough ore to be worth mentioning. The only ore milled from the present Mexican area consisted of 308 tons, assaying $13 per ton. This was taken from a stringer on the 2,700-foot level in 1883. In 1884 the Mexican 3,100-foot winze was sunk to the 3,300-foot level and three diamond-drill holes were driven. The results were disappointing and all work in the lower levels at the north end was discontinued. From that time until recently no work has been done in the mine below the Sutro tunnel level, at a depth of 1,600 feet. The Belcher, Crown Point, Yellow Jacket, Comstock-Phoenix, Hale & Norcross, Lady Bryan, and Savage were also producers in 1910.

WASHOE COUNTY.

From 17 deep mines a production was reported of 3,672 tons of ore, which is 566 tons less than were reported from 11 mines in 1909. The total average value of this ore in 1909 was $6.77 per ton, increasing to $13.18 in 1910, and the gold and silver value increased from $6.77 to $12.39 per ton. The larger part of the output of ore, aggregating 3,595 tons, was dry or siliceous in character, and 77 tons were classified as lead ore. The output of the county, including the placer production of $409 in gold and 9 ounces of silver, was $37,336 in gold, 15,147 ounces of silver, 644 pounds of copper, and 63,720 pounds of lead, valued in all at $48,400. The larger part of the tonnage, or 3,536 tons, was treated at milling plants, producing bullion valued at $34,761 in gold and 747 ounces of silver, the total valued at $35,164, or an average value of $9.94 per ton. Crude ore aggregating 136 tons was shipped directly to smelters, which contained $2,595 in gold, 14,400 ounces of silver, 644 pounds of copper, and 63,720 pounds of lead, having a total value of $13,237, or an average value of $97.33 per ton. The total output in 1910 showed a decrease of 566 tons in the tonnage produced, but an increase in all the metals over the production of 1909.

Jumbo or West Comstock district.—Reports of production were received for the Bargo and the Fink-Mahoney mines, which yielded in 1910 ore containing gold and silver and produced as bullion from amalgamation mills on each property.

Whitehorse district.—Thirteen mines in the vicinity of Olinghouse yielded 1,274 tons of ore, containing $22,838 in gold and 1,589 ounces of silver, with a total value of $23,696, or an average value of $18.60 per ton. The total value of this ore was four times the value of the

[1] Symmes, Whitman, Reopening the Mexican mine, Comstock Lode: Min. and Sci. Press, Mar. 19, 1910, p. 419.

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ore produced in 1909, when 4 mines were operated. The larger portion of the ore, or 1,237 tons, was treated at milling plants, and 37 tons of ore were shipped directly to smelters. The Buster, Keystone, Golden Eagle, Green Hill, and Jumper were producers in 1910.

Leadville district.—The Donnelly and the Tehoqua mines produced 111 tons of ore in 1910, carrying gold, silver, copper, and principally lead, which was mostly shipped to smelters.

WHITE PINE COUNTY.

Mine production of gold, silver, copper, and lead in White Pine County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	18,551.47	$383,493	22,134.71	$457,565	+ 3,583.24	+$74,072
Silver.....do....	110,325	57,369	199,222	107,580	+ 88,897	+ 50,211
Copper.....pounds..	57,508,146	7,476,059	63,930,278	8,119,145	+6,422,132	+643,086
Lead.....do....	1,043,629	44,876	586,589	25,810	− 457,040	− 19,066
Total.....	.....	7,961,797	.....	8,710,100	.....	+ 748,303

The production of 2,390,386 tons of ore in 1910 made from 24 mines was 715,058 tons greater than that made in 1909, when 22 mines were reported. No production was reported from placer properties. The total average value per ton of the ore produced decreased from $4.75 in 1909 to $3.64 in 1910, and the gold and silver value in this ore from 26 cents to 24 cents per ton. The larger part of the tonnage was the yield of the mines near Ely, and is largely classified as copper ore, there being only 14,780 tons of dry or siliceous ore, 1,303 tons of lead ore, and 87 tons of copper-lead ore credited to the county output for 1910. Nearly all the ore treated at concentration mills was copper ore and aggregated 2,346,684 tons, which produced concentrate containing gold, silver, and copper. Ore shipped directly to smelters aggregated 28,941 tons, containing gold, silver, copper, and lead, valued in all at $242,700, at an average value of $8.39 per ton.

Cherry Creek district.—Four mines in 1910 produced 13,928 tons of ore, which yielded $29,995 in gold, 88,247 ounces of silver, 9,622 pounds of copper, and 121,759 pounds of lead, valued at $84,227, or an average value of $6.05 per ton. The bulk of the ore was treated at milling plants, producing gold and silver bullion and concentrates, which contained gold, silver, copper, and lead. There were also shipped from the district 162 tons of lead ore containing gold and silver. The production of ore made by 5 mines in 1909 was valued at $19,670.

Duck Creek district.—The ore produced from 9 mines in 1910 aggregated 454 tons, containing $2,126 in gold, 2,912 ounces of silver, 6,459 pounds of copper, and 284,423 pounds of lead, valued in all at $17,034, or an average value of $37.52 per ton.

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Robinson (Ely) district.—The following table shows the production of Robinson or Ely district in 1909 and 1910:

Mine production of gold, silver, copper, and lead in Robinson district, White Pine County, Nev., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	17,926.28	$370,569	20,473.51	$423,225	+ 2,547.23	+$52.656
Silver.....do....	79.487	41,333	108,000	58,320	+ 28,513	+ 16,987
Copper.....pounds..	57,481.515	7,472,597	63,914,197	8,117,103	+6,432,682	+644.506
Lead.....do....	524,512	22,554	190,407	7,938	− 344.105	− 14,616
Total.....	.....	7,907,053	.....	8,606.586	.....	+699,533

Another record yield was made by the mines in the Robinson or Ely district in 1910. From 10 mines 2,375,032 tons of ore were produced, of which the bulk was treated at concentration mills, yielding principally copper and some lead concentrate. The same number of properties in 1909 yielded 1,671,225 tons of ore, 5 of which yielded 1,669,909 tons of copper ores. In 1910, 3 copper mines produced. The Ruth mine,[1] the mine that made the district known, is developed quite extensively and there is a large tonnage of ore available for caving, which is the system employed in mining. A new shaft, the Star Pointer, was sunk and connected with the old Ruth workings and will be the main outlet for the mine when shipments from it begin. The shaft is conveniently located on the railroad and is well equipped to handle 2,000 tons of ore per day. A drift from this shaft has been run under the old Ruth dump, which contains a large tonnage of commercial ore, to which an upraise has been driven and this ore by these workings will be transferred to and raised through the Star Pointer shaft. The present total tonnage produced by the Nevada Consolidated amounts to between 7,000 and 8,000 tons per day and comes almost wholly from the steam-shovel pits, which now cover about 35 acres and have a maximum depth of 185 feet. Five steam shovels are working here stripping overburden and mining ore. Three of these machines have 5-yard dippers, 1 has a 3½-yard dipper, and 1 has a 3-yard dipper. The first four are 95-ton, and the last a 70-ton shovel. The ore is hauled to the reduction works 20 miles up the valley in trains of 20 cars each. For the company's fiscal year ending September 30, 1910, the Nevada Consolidated mined and treated 2,236,434 tons of ore, which averaged 2.06 per cent of copper. The overburden stripped and disposed of amounted to 1,163,069 cubic yards, plus 329,346 cubic yards removed for approach work, making a total of 1,492,415 cubic yards. The total stripping cost was 40.6 cents per yard, equivalent to 15 cents per ton of ore. The mining costs were 15.4 cents per ton. The total cost of mining, including every expense, stripping, taxes, eastern office expense, etc., amounted to 30.4 cents per ton of ore. The Nevada Consolidated has now reported blocked out 40,360,000 tons of ore, which averages 1.7 per cent of copper, besides proved

[1] Barbour, Percy E., The Ely mining district, Nevada; Mines and Minerals, August, 1911, p. 62.

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ore reserves of 18,000,000 tons, averaging 1.25 per cent of copper. Although the Nevada Consolidated is now the only large producer in Ely, the Giroux, controlled by the Cole-Ryan interests, is expected to be soon a large factor in the output of the camp. The mine, although extensively developed, has never been a producer, except on a sufficient scale to furnish ore for the experimental mill at Kimberly. A small smelter was also erected here, but the building burned down before the single-blast furnace was blown in, and it is now wholly unsuited in size, in type, and in location for present needs. A 2,000-ton concentrator and smelter are in prospect. Water for this experimental plant was obtained from the 1,000-foot level of the company's Alpha shaft, and was ample for the purpose. Underground development and churn drilling from the surface have been carried on aggressively with continuously satisfactory results. The reduction works at McGill, including both the concentrator and the smelter, are known as the Steptoe Valley plants and are owned by the Steptoe Valley Smelting & Mining Co. This company is now owned by the Nevada Consolidated. The concentrator was originally designed for less than 6,000 tons per day, but recent additions of various improvements have largely increased its capacity until it is now treating over 8,000 tons per day. The ore is crushed by rolls and Chili mills and is concentrated on Wilfley tables and Frue vanners. The concentrates are dewatered in steel tanks and are then loaded by means of Blaisdell excavators nto trains of cars, running underneath the tanks. Milling costs 55 cents per ton of ore. The ratio of concentration is 10.6 and the recovery is 69.5 per cent There are employed in and about the mill about 300 men, millmen and laborers. During the last fiscal year the Steptoe plants produced 60,513,009 pounds of refined copper. For the last quarter of the year the total cost of producing copper was reported as 6.8 cents per pound and for the whole year the cost averaged 7.05 cents.

Osceola district.—The San Pedro mine at Black Horse yielded gold and silver ore, which was treated at its amalgamation mill in 1910. In 1909 there were 2 lode mines and 4 placers producing, which yielded $5,977 in gold and 85 ounces of silver.

NEW MEXICO.[1]

By CHARLES W. HENDERSON.

PRODUCTION.

The total value of the production of gold, silver, copper, lead, and zinc in New Mexico for 1910, as reported from 108 productive mines, 23 of which were placers, amounted to $2,691,080. As compared with $2,070,368 in 1909, this shows an increase in value for 1910 of $620,712. The gold yield was 23,337.26 fine ounces, valued at $482,424, an increase in 1910 of 11,751.88 fine ounces in quantity and of $242,933 in value. The silver yield was 843,987 fine ounces, an increase of 446,204 fine ounces in quantity and of $248,906 in value. The copper output was 4,614,386 pounds, a decrease in 1910 of 778,760 pounds; the lead output was 4,320,841 pounds, a decrease

[1] Lindgren, W., Graton, L. C., and Gordon, C. H., The ore deposits of New Mexico: Prof. Paper U. S. Geol. Survey No. 68, 1910.

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of 708,926 pounds; and the zinc output was 18,088,129 pounds, an increase of 5,002,184 pounds. The value of the base metals showed a decrease of $115,082 for copper and of $26,163 for lead; the value of the zinc produced showed an increase of $270,118.

There were 191,865 short tons of ore sold or treated in 1910, which averaged $13.89 in total value per ton, as compared with 164,156 tons, averaging $12.48 per ton, in 1909, with 135,434 tons, averaging $11.09, in 1908, and with 219,992 tons, averaging $14.64, in 1907. The tonnage of siliceous or dry ore and of the combined lead-zinc and zinc ores increased, while the tonnage of copper, copper-lead, and lead ores decreased; the increase in total tonnage was 27,709 tons. The average recovered value per ton in 1910 in gold and silver was $9.298 in siliceous ore, $1.132 in copper ores, $2.58 in lead ores, $40.133 in copper-lead ores, and $1.22 in lead-zinc ores.

During 1910 there were treated in amalgamating or cyaniding mills in New Mexico 67,148 tons of ore, and the bullion saved amounted to $293,973 in gold, an average value per ton of $4.38, and $222,627 in silver, an average value per ton of $3.31; the total value in gold and silver was $516,600, an average value of $7.69. The recovery as bullion per ton of ore treated in 1909 was $4.23 in gold and $2.69 in silver, a total of $6.92, showing for 1910 an average increase of $0.77 per ton in gold and silver recovered as bullion.

From 61,379 tons treated at mills by concentration or magnetic separation there were produced 18,298 tons of concentrates (ratio 3.36 to 1[1]), valued at $93,768 in gold, an average per ton of $5.12, and $137,732 in silver, an average value per ton of $7.53, the total value in gold and silver being $231,500, with an average of $12.65 per ton. For those concentrates which carried copper (however small) the average assay (dry) was 7.61 per cent; for those concentrates which carried lead the average assay (dry) was 27.16 per cent; for zinc concentrates the average assay of zinc content was 38.45 per cent.

From the 128,527 tons to all classes of mills there were produced $387,741 in gold, from both bullion and concentrates, at an average recovery of $3.02 per ton, and $360,359 in silver, at an average recovery of $2.80 per ton, a total recovery in gold and silver of $748,100, at an average total of $5.82 in these two metals for all ore milled. The average total value in gold and silver recovered in 1909 from 112,612 tons milled was $2.86 per ton, an increase for 1910 of $2.96 per ton.

Crude ore shipped to smelters amounted to 63,338 short tons, containing $68,589 in gold, averaging $1.082 (or 0.052 ounce) per ton; 176,281 ounces of silver, valued at $95,192, averaging 2.178 ounces, or $1.503 per ton, the total value in gold and silver being $163,781, and the average per ton $2.585, as compared with $2 in 1909. Crude ore to smelters also contained 3,564,148 pounds of copper, averaging 2.81 per cent, and 1,618,998 pounds of lead, averaging 1.28 per cent. Much of this ore carried neither copper nor lead; that which carried copper averaged 4.74 per cent; that which carried lead averaged 6.65 per cent.

[1] The ratio of the tonnage of the product from magnetic separating mills, as compared with the tonnage treated, is lower than in wet-milling practice.

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Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity	Value.
Gold.....fine ounces..	11,585.38	$239,491	23,337.26	$482,424	+11,751.88	+$242,933
Silver.....do....	397,783	206,847	843,987	455,753	+ 446,204	+ 248,906
Copper.....pounds..	5,393,146	701,109	4,614,386	586,027	− 778,760	− 115,082
Lead.....do....	5,029,767	216,280	4,320.841	190,117	− 708,926	− 26,163
Zinc.....do....	13,065,945	706,641	18,088,129	976,759	+ 5,002,184	+ 270,118
Total.....	.....	2,070,368	.....	2,691,080	.....	+ 620,712

The following table shows the production of gold, silver, copper, lead, and zinc in New Mexico in 1910, by counties:

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1910, by counties.

County.	Tonnage.	Gold.		Silver.	
		Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*	
Bernalillo	24	.....	.....	37	$20
Colfax	93	629.89	$13,021	261	141
Dona Ana	2	.....	.....	15	8
Grant	[a] 68,882	3,189.46	65,932	156,557	84,541
Lincoln	10,727	2,673.98	55,276	559	302
Luna	525	1.26	26	2,484	1,341
Otero	2,545	415.10	8,581	2,046	1,105
Santa Fe	4,739	393.73	8,139	3,359	1,814
Sierra	8 306	565.84	11,697	15.778	8,520
Socorro	[a] 96,022	15,050.14	311,114	662,000	357,480
Unapportioned	.....	417.86	8,638	891	481
Total	191,865	23,337.26	482,424	843,987	455,753

[a] A portion of Grant County tonnage included in that of Socorro County.

County.	Copper.		Lead.		Zinc.		Total. value.
	Quantity.	value	Quantity.	Value.	Quantity.	Value.	
	Pounds		*Pounds.*		*Pounds.*		
Bernalillo	.....	.....	24.568	$1,081	.....	.....	$1,101
Colfax	.....	.....	2,182	96	.....	.....	13,258
Dona Ana	.....	.....	705	31	.....	.....	39
Grant	4,404,394	559,358	257.953	11,350	(a)	(a)	[a] 721,181
Lincoln	189	24	5,614	247	.....	.....	55,849
Luna	47	6	298,112	13,117	.....	.....	14,490
Otero	49,874	6,334	6,046	266	.....	.....	16,286
Santa Fe	5,150	654	262,023	11,529	74,759	$4,037	26,173
Sierra	2,448	311	11,274	496	.....	.....	21,024
Socorro	152,284	19,340	3,452,364	151,904	[a]18,013,370	[a] 972,722	[a]1,812,560
Unapportioned	.....	.....	.....	.....	.....	.....	9,119
Total	4,614,386	586,027	4,320,841	190,117	18,088,129	976,759	2,691,080

[a] Zinc combined with that of Socorro County.

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Tonnage of ore to gold and silver mills and concentrating mills, with quantity of gold and silver bullion produced in New Mexico in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills (short tons).
	Quantity (short tons).	Gold in bullion (value).	Silver in bullion (fine ounces).	
Grant	.....	$1,105	63	31,922
Lincoln	10,718	53,876	532	.....
Otero	.....	.....	.....	2,000
Santa Fe	122	3,378	50	4,580
Sierra	4,500	8,918	172	2,772
Socorro	51,808	219,655	410,631	20,105
Unapportioned	.....	7,041	824	.....
Total	67,148	293,973	412,272	61,379

Mine production of gold, silver, copper, lead, and zinc from New Mexico concentrates in 1910, by counties.

County.	Quantity (short tons).	Gold (value).	Silver (fine ounces).	Copper (pounds).	Lead (pounds).	Zinc (pounds).
Grant	1,880	.....	.....	928,399	.....	.....
Otero	22	.....	35	9,055	.....	.....
Santa Fe	335	$320	3,237	906	261,955	74,759
Sierra	73	2,116	14,991	1,602	9,160	.....
Socorro	15,988	91,322	236,797	110,186	2,430,728	6,807,416
Total	18,298	93,768	255,060	1,050,238	2,701,843	6,882,175

Mine production of gold, silver, copper, lead, and zinc from New Mexico crude ore shipped to smelters in 1910, by counties.

County.	Crude ore (short tons).	Gold (value).	Silver (fine ounces).	Copper (pounds).	Lead (pounds).	Zinc (pounds).
Bernalillo	24	.....	37	.....	24,568	.....
Colfax	93	$3,433	122	.....	2,182	.....
Dona Ana	2	.....	15	.....	705	.....
Grant	[a] 36,960	62,186	156,450	3,475,995	257,953	(a)
Lincoln	9	.....	20	189	5,614	.....
Luna	525	26	2,434	47	298,112	.....
Otero	545	2,559	1,911	40,819	6,046	.....
Santa Fe	37	179	57	4,244	68	.....
Sierra	1,034	79	613	756	2,114	.....
Socorro	[a] 24,109	127	14,572	42,098	1,021,636	[a]11,205,954
Total	63,338	68,589	176,281	3,564,148	1,618,998	11,205,954

[a] Grant and Socorro tonnage of zinc ore and zinc combined to conceal individual production.

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Tonnage of ore sold or treated, number of deep mines producing, by counties, and average value per ton of ore mined in New Mexico in 1909 and 1910.

County.	Short tons of ore sold or treated.		Number of deep mines producing.	
	1910	Increase (+) or decrease (−).	1909	1910
Bernalillo	24	+ 4	2	1
Colfax	93	+ 10	1	2
Dona Ana	2	− 2,814	6	1
Grant	[a] 68,882	−20,694	50	39
Lincoln	10,727	+ 7,094	8	6
Luna	525	− 638	9	9
Otero	2,545	+ 2,402	3	6
San Miguel	.....	− 11	1	.....
Santa Fe	4,739	+ 1,908	2	4
Sierra	8,306	+ 4,012	18	6
Socorro	[a] 96,022	+36,436	11	11
Total	191,865	+27,709	111	85
Average value per ton	.....	.....	$12.48	$13.89

[a] Tonnage of zinc ore of Grant and Socorro counties combined, to conceal individual production.

GOLD.

The total gold production for New Mexico in 1910 amounted to 23,337.26 fine ounces, valued at $482,424, as against 11,585.38 fine ounces, valued at $239,491 in 1909, an increase of 11,751.88 fine ounces in quantity and of $242,933 in value. Socorro County alone produced 15,050.14 fine ounces, valued at $311,114, or 64 per cent of the total gold yield. This was almost entirely from the siliceous ore mines at Mogollon. There were also increased gold yields in Grant, Lincoln, Otero, and Sierra counties, chiefly from siliceous and copper ores. Siliceous ore furnished in the whole Territory 20,578.63 fine ounces, valued at $425,398, or 88.2 per cent of the total, copper ores contained 1,449.41 fine ounces of gold, valued at $29,962, or 6.2 per cent of the total, chiefly from Grant and Otero counties; lead ores contained 12.38 fine ounces, valued at $256, or 0.1 per cent of the total. Placer gold amounted to 1,262.30 fine ounces, valued at $26,094, or 5.4 per cent of the total. The gold in copper-lead, lead-zinc, and zinc ores was negligible.

Source of gold production in New Mexico, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placer mines.	Deep mines.					Total.
		Dry or siliceous ore.	Copper ores.	Lead ores.	Copper-lead ores.	Lead-zinc ores.	
Bernalillo	.....	.....	.....	.....	.....	.....	.....
Colfax	463.82	166.07	.....	.....	.....	.....	629.89
Dona Ana	.....	.....	.....	.....	.....	.....	.....
Grant	127.76	1,735.27	1,317.20	9.23	.....	.....	3,189.46
Lincoln	67.73	2,606.25	.....	.....	.....	.....	2,673.98
Luna	.....	.....	.....	1.26	.....	.....	1.26
Otero	291.31	.....	123.55	.24	.....	.....	415.10
Santa Fe	206.18	163.41	8.66	.....	.....	15.48	393.73
Sierra	28.25	537.49	.....	.10	.....	.....	565.84
Socorro	.....	15,029.53	.....	1.55	2.52	16.54	15,050.14
Unapportioned	77.25	340.61	.....	.....	.....	.....	417.86
Total, 1910	1,262.30	20,578.63	1,449.41	12.38	2.52	32.02	23,337.26
Total, 1909	1,064.73	10,052.35	397.80	70.50	.....	.....	11,585.38
Increase (+) or decrease (−)	+197.57	+10,526.28	+1,051.61	−58.12	+2.52	+32.02	+11,751.88

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SILVER.

The silver yield in 1910 amounted to 843,987 fine ounces, valued at $455,753, as compared with 397,783 fine ounces, valued at $206,847 in 1909, an increase for 1910 of 446,204 fine ounces in quantity and of $248,906 in value. Of the total, Socorro County produced 662,000 fine ounces, or 78.4 per cent, chiefly from siliceous ore from Mogollon district, though there was an appreciable quantity from the lead-zinc ores from Magdalena. Grant County furnished 156,557 fine ounces, or 18.5 per cent of the total, chiefly from siliceous, copper, and lead ores, with a small quantity from zinc ores and placers. The yield of silver from Grant and Socorro counties combined was 97 per cent of the total.

Siliceous ores, chiefly from Grant, Sierra, and Socorro counties, furnished 708,762 fine ounces, or 84 per cent of the total; copper ores, chiefly from Grant County, with a small quantity from Otero and Socorro counties, furnished 60,228 ounces, or 7 per cent; lead ores, chiefly from Grant, Luna, Sierra, and Socorro counties, furnished 19,040 ounces, or 2.3 per cent; and lead-zinc ores, from Santa Fe and Socorro counties furnished 54,550 ounces, or 6.5 per cent of the total.

Source of silver production in New Mexico, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placer mines.	Deep mines.						Total.
		Dry or siliceous ore.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	
Bernalillo	.....	.....	.....	37	.....	.....	.....	37
Colfax	139	122	.....	.....	.....	.....	.....	261
Dona Ana	.....	.....	.....	15	.....	.....	.....	15
Grant	44	94,213	58,067	4,218	15	.....	.....	156,557
Lincoln	7	532	.....	20	.....	.....	.....	559
Luna	.....	.....	.....	2,484	.....	.....	.....	2,484
Otero	100	.....	1,837	109	.....	.....	.....	2,046
Santa Fe	15	50	57	.....	.....	.....	3,237	3,359
Sierra	2	15,174	.....	602	.....	.....	.....	15,778
Socorro	.....	597,847	267	11,555	.....	1,018	51,313	662,000
Unapportioned	67	824	.....	.....	.....	.....	.....	891
Total, 1910	374	708,762	60,228	19,040	15	1,018	54,550	843,987
Total, 1909	162	323,962	23,318	34,463	.....	194	15,684	397,783
Increase (+) or decrease (−)	+212	+384,800	+36,910	−15,423	+15	+824	+38,866	+446,204

COPPER.

In 1910 the copper output of New Mexico amounted to 4,614,386 pounds, valued at $586,027, a decrease of 778,760 pounds as compared with the output in 1909, and a decrease of 1,498,244 pounds as compared with the yield in 1908. Grant County, chiefly from the Central district (near Fierro, Hanover, and Santa Rita) and the Lordsburg district, produced 4,404,394 pounds in 1910, or 95 per cent of the total. The output from Grant County was 772,191 pounds less than in 1909. Other decreases were in Dona Ana, Lincoln, Luna, Sierra, and Socorro counties, none of which, with the exception of Socorro County, produces copper in any appreciable quantity.

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Otero County showed an output of 49,874 pounds, an increase for 1910 as compared with the yield in 1909, but an insignificant increase when compared with the yields in 1907 and 1908, which were 679,480 pounds and 723,907 pounds, respectively. Santa Fe County, which ranked second to Grant County in yield of copper in 1907, with no copper output in 1908, and with a very small yield in 1909, yielded 5,150 pounds in 1910. Socorro County's copper output was 152,284 pounds, chiefly from selected lots of crude ore, from a small content of copper in lead ore and lead concentrates, from the lead-zinc ores of the Magdalena district, and from a small output from Good Fortune Creek, east of Engle.

True copper ores (containing over 2.5 per cent of copper by dry assay) of Grant, Otero, Santa Fe, Sierra, and Socorro Counties furnished 3,961,406 pounds, or 85.9 per cent of the total; siliceous or dry ore from Grant County (chiefly from the siliceous ore of Lordsburg district) and from the Hillsboro district of Sierra County, the copper being recovered as concentrates, furnished 527,141 pounds, or 11.4 per cent; lead ores, chiefly from the Central and San Simon districts, Grant County, the Magdalena district, Socorro County, and the Nogal district, Lincoln County, yielded 13,242 pounds, or 0.3 per cent; concentrates from the lead-zinc mines of Magdalena, Socorro County, and Los Cerrillos, Santa Fe County, contained 111,092 pounds of copper, or 2.4 per cent; and copper-lead ores of Socorro County furnished 1,505 pounds.

There were 3,564,148 pounds of copper contained in crude ore to smelters, representing 77 per cent of the total; concentrates carried 1,050,238 pounds, or 23 per cent.

In point of production during 1910, the Central district (including Fierro, Hanover, and Santa Rita camps), Grant County, is the first copper district in New Mexico, with Lordsburg second. The most productive property in the Central district has been the Santa Rita mines of the Chino Copper Co., at Santa Rita. The output from this property was, however, confined in 1910 to mining operations of lessees and experimental mill operations in the company's 100-ton mill. This company in 1909 acquired a large acreage of mineral lands, including the Santa Rita mines, and has been prospecting systematically with churn drills. The intention is to mine partly by underground methods and partly by steam shovels. The interim report of this company, covering the period from May 31, 1910, to May 1, 1911, says in part:

> The average grade of the total quantity of developed and partially developed ore shown by calculations * * * is 2.3 per cent and the total tonnage so shown is 45,238,312 tons. This tonnage includes ores that will be mined both by steam-shovel and underground methods. Of this quantity something more than 32,000,000 tons, or over 71 per cent, will be mined by steam shovel. * * *
>
> Two 90-ton steam shovels were received in September [1910], and started on stripping in that month. A third was put in operation in November, and a fourth in December. A 40-ton shovel was also installed in December, making 5 in all now in operation. * * * The mine has been provided with all necessary facilities * * * and is at present in position to produce ore as fast as the mill would require it if it were now ready for operation.
>
> Grading for the mill was started July, 1910. * * * This plant is being built in three sections, each to have a capacity of 1,000 tons per day.

It was expected that one section of the company's mill would be ready for operation by the middle of July, 1911.

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In Otero County the Tularosa Copper Co. built a 100-ton concentrating mill, which was completed in October, 1910. Copper concentrates were shipped to El Paso, Tex.

Source of copper production in New Mexico, by kinds of ore, in 1910, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ores.	Lead ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Grant	525,307	3,871,661	7,426	.....	.....	4,404,394
Lincoln	.....	.....	189	.....	.....	189
Luna	.....	.....	47	.....	.....	47
Otero	.....	49,874	.....	.....	.....	49,874
Santa Fe	.....	4,244	.....	.....	906	5,150
Sierra	1,834	567	47	.....	.....	2,448
Socorro	.....	35,060	5,533	1,505	110,186	152,284
Total	527,141	3,961,406	13,242	1,505	111,092	4,614,386

LEAD.

Lead decreased in output from 5,029,767 pounds in 1909 to 4,320,841 pounds in 1910. The total output in 1910 was valued at $190,117.

The greatest yield was from the Magdalena district, Socorro County. Socorro County produced 3,452,364 pounds; Dona Ana County, from the Organ district, in 1909 yielded 772,023 pounds, but a negligible amount in 1910; Grant County, 257,953 pounds; Luna County, from the Florida and Victorio districts, yielded 298,112 pounds; Santa Fe County, from the Cerrillos district, 262,023 pounds; and Otero County, from the Silver Hill district, 6,046 pounds. Concentrates produced in 1910 contained 2,701,843 pounds of lead, and crude ore sent to smelters contained 1,618,998 pounds.

Lead ores furnished 1,562,427 pounds of lead, and lead-zinc ores 2,692,683 pounds, the combined contents representing 98.5 per cent of the lead production. Siliceous ores yielded slightly more than 1 per cent of the total.

Source of lead production in New Mexico, by kinds of ore, in 1910, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ores.	Lead ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Bernalillo	.....	.....	24,568	.....	.....	24,568
Colfax	2,182	.....	.....	.....	.....	2,182
Dona Ana	.....	.....	705	.....	.....	705
Grant	45,162	.....	212,791	.....	.....	257,953
Lincoln	.....	.....	5,614	.....	.....	5,614
Luna	.....	.....	298,112	.....	.....	298,112
Otero	.....	3,250	2,796	.....	.....	6,046
Santa Fe	.....	68	.....	.....	261,955	262,023
Sierra	9,160	.....	2,114	.....	.....	11,274
Socorro	.....	.....	1,015,727	5,909	2,430,728	3,452,364
Total	56,504	3,318	1,562,427	5,909	2,692,683	4,320,841

ZINC.

The total recoverable zinc, whether marketed as spelter or oxide, from crude ore and concentrates (or separation products), figured in terms of spelter, shipped from New Mexico mines in 1910, was

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18,088,129 pounds, valued at $976,759. In 1909 the output was 13,085,945 pounds, valued at $706,641. In terms of marketable metal, the value of the zinc contained in ore from New Mexico was worth $390,732 more than the copper yield and $494,335 more than the gold output.

Mines producing zinc in New Mexico are at Kelly, Socorro County; at Hanover, Grant County; and near Los Cerrillos, Santa Fe County. The output from all three districts was larger in 1910 than in 1909. In order to avoid disclosing the output of the zinc mines of Grant County, the output of zinc from Grant and Socorro counties is combined.

The ore from the Grant County mines is shipped crude, that from Socorro County is in part shipped crude and in part separated magnetically and by wet milling, and that from Santa Fe County is shipped as concentrates.

Source of zinc production in New Mexico, by kinds of ore, in 1910, by counties, in pounds.

County.	Zinc ores.	Lead-zinc ores.	Total.
Grant and Socorro	11,205,954		18,088,129
Santa Fe and Socorro		6,882,175	

TONNAGE.

Subdivision of tonnage of ore sold or treated in New Mexico in 1910, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Bernalillo			24				24
Colfax	93						93
Dona Ana			2				2
Grant	15,831	52,487	564	(a)			[a] 68,882
Lincoln	10,718		9				10,727
Luna			525				525
Otero		2,522	23				2,545
Santa Fe	122	37				4,580	4,739
Sierra	8,299	1	6				8,306
Socorro	51,854	173	2,931	[b] 20,944	15	20,105	[b] 96,022
Total 1910	86,917	55,220	4,084	20,944	15	24,685	191,865
Total 1909	47,081	81,144	6,820	193	25	28,893	164,156
Increase (+) or decrease (−)	+39,836	−25,924	−2,736	+20,751	−10	−4,208	+27,709

[a] Grant County zinc ore included in Socorro County.
[b] Includes Grant County zinc ore.

SMELTERS.

The El Paso, Tex., smelter and the Copper Queen smelter, at Douglas, Ariz., continued to handle the smelting lead and copper ores and concentrates from New Mexico. All zinc ore and concentrates were shipped out of the Territory. Some lead and zinc ore was also shipped to Pueblo, Colo., and copper ore also went to the Shannon smelter, Clifton, Ariz. All the smelters within the Territory were idle. These are the Comanche, at Silver City, Grant County; the Oro Grande, Otero County; the Santa Fe, at San Pedro, Santa

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Fe County; the lead smelter of the National Mining & Smelting Co., at Deming, Luna County, and the zinc plant at Los Cerrillos, Santa Fe County.

MINING INDUSTRY IN NEW MEXICO IN 1910.

Mining in New Mexico in 1910 was on a decidedly more stable basis than it has been for some years. The increase in gold and silver production is only indicative of future increases, judging from the amount of development work done in 1910, and the building of new mills, particularly in the Mogollon district, Socorro County. This district, 80 miles from a railroad, has so adapted the cyanide and concentration process that the greater part of the product is in the form of bullion, which can be carried to the market by automobile. Comparisons of average values recovered as bullion show that in 1910 the ore from Mogollon averaged $4.22 per ton in gold, as compared with $3.30 in 1909, an increase of $0.92; and that the silver recovery increased from 6.91 ounces to 8.12 ounces per ton; but whether this came about because of higher grade ore or through better recovery was not ascertained. White Oaks, Lincoln County, doubled its gold production in 1910 from auriferous pyritic quartz veins. Increased shipments of gold-bearing copper and dry ores from the fissure veins of Lordsburg increased the output of gold in Grant County. Otero County's increased gold output came from placers and gold-bearing copper ores from the Jarilla district near Oro Grande. Operations in the Las Animas district, near Hillsboro, Sierra County, yielded a slightly increased gold output. Placer output, near Elizabethtown, Colfax County, was on the decline, but the resuscitation of two of the old lode mines in that district helped to maintain the gold yield of that county.

The decrease in copper production was the result more of a matter of management than of lack of ores, the decrease being in Central district, Grant County, where the Chino Copper Co. marketed only such ores as were taken out in underground development, that company reporting that 134,000 tons of copper ore was stored in stock piles on March 1, 1911, from stripping operations since September, 1910. The 100-ton concentrating plant of this company, used for experimental purposes, was closed in August, 1910. The company plans to start in July, 1911, one section of 1,000 tons capacity of its new 3,000-ton mill at Hurley, construction of which started July, 1910. Although there was a decreased output from the Burro Mountain copper district in Grant County, there was active development on the part of five companies, both on the surface with churn drills and underground. The copper output from Lordsburg, Grant County, in 1910 was almost three times that of 1909. Although there was a small production from Pinos Altos district, Grant County, in 1910, there was a great deal of development work done on the Pacific and the Western Belle properties.

The decrease in lead output was caused chiefly by the idleness of the lead mines of the Organ district, Dona Ana County. Lead and lead-zinc ores of the Magdalena district, Socorro County, yielded an increased production of lead from that county.

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The mines at Kelly, Socorro County, were operated steadily during 1910, with a resultant increase in zinc output. The Tri-Bullion Smelting and Development Co. operated regularly its magnetic mill and wet mills (both combined having a capacity of 1,800 tons per month) on ore from the Tri-Bullion group and the Starlight mines. Crude lead and zinc ore was shipped by lessees from the Kelly property of this company. The Ozark Smelting & Mining Co. shipped sulphide zinc ore to the company's oxide plant at Coffeyville, Kans., and also experimented with the flotation process at the mill at Kelly. The Mistletoe Mining Co. in experimental work treated lead-zinc carbonate in a 50-ton concentrator, using Sutton, Steele, and Steele dry tables. All three of these companies also carried on development work in 1910. The American Zinc, Lead & Smelting Co. was occupied in 1910 in driving a long adit to open the Lynchburg group.

Surface prospecting on the Cleveland mine, in Pinos Altos district, opened up zinc carbonate, and a 50-ton mill was started in 1910, which it is reported makes a clean zinc product by screening.

There was an increased tonnage of zinc ores shipped from Hanover, Grant County, in 1910.

REVIEW BY COUNTIES.

BERNALILLO COUNTY.

The Octoroon Mining Co., in the Soda Springs district, shipped a small tonnage of lead ore to El Paso, Tex., in 1910. The mine is opened by a 45-foot vertical shaft, a 35-foot winze, and a 400-foot tunnel. Considerable assessment and development work was done in this county in 1910, in the Coyote, Carnuel, Hell Canon, and Soda Springs districts.

COLFAX COUNTY.[1]

Near Elizabethtown and Baldy, Colfax County, is the principal gold placer district in New Mexico. This district, from 5 mines and various small pannings and washings, produced $9,588 in placer gold in 1910, as compared with $16,037 in 1909 and with $11,274 in 1908. Ore was shipped from the Aztec and the Montezuma deep mines. The Ute Park Gold Mining Co., operating the Montezuma mine, reports that the mine is opened by 5 old and 4 new tunnels, each about 500 feet long, and that on the property is a 40-stamp amalgamating mill. Experiments toward treating the ore by the cyanide process have proved satisfactory. The Aztec property is equipped with a 40-stamp mill with Wilfley tables, built several years ago. The development consists of several tunnels and shafts, the greatest depth attained being 220 feet. One adit is 1,000 feet long. The Baldy tunnel, owned by the Gold & Copper Deep Tunnel Mining & Milling Co., was advanced 300 feet in 1910, making a total length of 3,000 feet. There is a 20-ton amalgamation plant near the tunnel mouth.

[1] Graton, L. C., The ore deposits of New Mexico: Prof. Paper U. S. Geol. Survey No. 68, 1910, pp. 91-108.

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DONA ANA COUNTY.

With the exception of a small test lot of lead ore shipped from the Philadelphia mine in the Organ district, there was no production from Dona Ana County in 1910. In performing development work on the Big Three mine, ore was placed on the dump. The Bennett-Stephenson, Memphis, Mormon, Sunflower, Torpedo, and Victoria mines were not operated in 1910.

GRANT COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Grant County, N. Mex., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,829.83	$37,826	3,189.46	$65,932	+1,359.63	+$28,106
Silver.....do....	74,198	38,583	156,557	84,541	+ 82,359	+ 45,958
Copper.....pounds..	5,176,585	672,956	4,404,394	559,358	− 772,191	−113,598
Lead.....do....	215,070	9,248	257,953	11,350	+ 42,883	+ 2,102
Total.....	.....	758,613	.....	721,181	.....	− 37,432
Zinc.....pounds..	203,278	10,977	(a)	(a)	Increase.	Increase.
Total.....	.....	769,590	(a)	(a)	Increase.	Increase.

a Included with Socorro County.

Grant County ranked second to Socorro both in point of tonnage sold or treated and in total value of the product. There was an increased output from this county in 1910 in gold, silver, lead, and zinc, but a considerable decrease in copper. In production of copper, however, Grant County ranked first, with 95 per cent of the total output. With the starting of the first 1,000-ton unit of the Chino Copper Co.'s mill, at Santa Rita, after June, 1911, Grant County promises a greatly increased output in this metal for 1911. Grant and Socorro counties combined produced the greater part of the zinc yield for New Mexico, a small output being made in Santa Fe County. (To avoid disclosing the output of individual mines, the zinc output of Grant County is combined with that of Socorro.) There were 39 producing deep mines in Grant County in 1910, as compared with 50 in 1909.

The yield from placers in the Pinos Altos district showed a considerable decrease.

Production of siliceous and dry ores (carrying copper under 2.5 per cent) amounted to 15,831 short tons, as compared with 7,884 tons in 1909 and 4,327 in 1908. Copper ores formed the bulk of the tonnage with 52,487 tons, a decrease of 28,594 tons. The remainder was lead and zinc ores.

In 1908 and 1909 the greater part of the ore mined in Grant County was concentrated. However, in 1910 over one-half of the tonnage, amounting to 36,960 tons, was shipped crude to smelters. The average assay per ton of smelting ore was 0.081 ounce in gold and 4.23 ounces in silver. The average assay of that ore which carried copper was 4.9 per cent copper, and of that which carried lead was 6.3 per cent lead.

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From the 31.922 tons concentrated were produced 1,880 tons of concentrates (ratio 16 to 1), the average assay per ton of which was 24.6 per cent in copper, no other metals being recovered in the concentrates.

Apache district.—There were no operations in this district in 1910.

Burro Mountain district.—This district, southwest of Silver City, near Leopold and Tyrone, produces chiefly copper, with small quantities of gold and silver. There was a decided decrease in output in 1910. The Burro Mountain Copper Co. continued active development work, but ran the 300-ton concentrating mill only several days. This company sank 7,340 feet of churn drill holes and drove 11,230 feet of drifts. There is a 350-foot vertical shaft on the property. Other producing mines were the Gold Coin and the Virtue, from which crude ore was shipped to smelters. The Chemung Copper Co. did much development work, which has been continuous since May, 1906. The development on this property consists of 3 vertical shafts, respectively, 532 feet, 722 feet, and 421 feet deep, and 1 incline shaft 200 feet deep. The total underground development, including shafts, to the end of 1910, was 45,784 feet, of which 8,121 feet were run in 1910. The Mangus Co. prospected with churn drills. The Ocala Copper Co.'s shaft was sunk from 80 feet to 345 feet. The Burro Mountain properties of the Savanna Copper Co. were prospected with churn drills.

Central district.—The Central district, embracing the towns of Bayard, Fierro, Hanover, and Santa Rita, continued to be the most productive district in Grant County, with Lordsburg district second in point of output. The copper output of Central district was 2,679,630 pounds, as compared with 3,348,808 pounds in 1909 and with 3,994,502 pounds in 1908. The zinc output was larger than in 1909. There were six producing mines in this district. Shipments of copper ore were made from the Hanover mine by the Copper Queen Consolidated Mining Co. Lead ore was shipped from the Mimbres and San Jose mines. Zinc ore was shipped from the Black Jack and from the Empire Zinc Co. mines.

The Santa Rita mines and 100-ton concentrating plant was operated by lessees and by the Chino Copper Co. This mill was closed August, 1910. Including the Santa Rita mines, this company has acquired a total area of 2,652 acres of mining property, which will be mined by both steam shovel and underground methods, and the ore will be treated in a 3,000-ton concentrating plant, construction of which was started at Hurley July, 1910.

Since May 31 [1910], 138 drill holes have been completed or were in process of drilling on March 1 [1911], bringing the total number of holes drilled to March 1 up to 414 holes, 6 of which are still being drilled, 408 holes having been completed. The total footage of drilling on the property was, on March 1, 150,645, of which 56,609 feet were drilled from May 31, 1910, to March 1, 1911. The total number of holes drilled in ore was 318, having a total length of 123,393 feet. The number of holes entering into the calculation of ore developments * * * is 289. The average depth of these holes is 382 feet, the average thickness of ore 107 feet, the average thickness of capping 82 feet. * * * The average grade of the total quantity of developed and partially developed ore shown by calculations * * * is 2.3 per cent copper, and the total tonnage * * * is 45,238,312 tons. This tonnage includes ores that will be mined both by steam shovel and underground methods. Of this quantity something over 32,000,000 tons, or over 71 per cent, will be mined by steam shovel. * * *

Seven drills are now [May 1, 1911] being used in development. * * * Very little underground development has been done since the last report [1910], this con-

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sisting of work in the vicinity of the Santa Rita shaft. The sinking of this shaft was continued to a total depth of 529 feet. * * * It will not be necessary to do any underground mining at all until the ores from the steam-shovel areas developed are extracted, and all mining for a great many years can therefore be done with shovels.

Two 90-ton steam shovels were received in September [1910] and started on stripping in that month. A third was put in operation in November, and a fourth in December. A 40-ton shovel was also installed in December. * * *

In connection with steam-shovel operations we have constructed something over 6 miles of stripping and ore tracks about the property. Up to March 1, 1911, 334,000 yards of stripping have been moved and 134,000 tons of ore mined and stored in stock piles. * * * The ore bodies already uncovered and prepared for steam-shovel mining will supply tonnage for the mill for about three years. * * *

[The mill] is being built in three sections, each to have a capacity of 1,000 tons per day. * * * We now estimate that we will be able to put one section of the mill in commission by or before the middle of July. * * *[1]

Chloride Flat district.—The Bohemian Mining Co., operating the Grand Central mine, shipped an increased tonnage of siliceous ore, carrying silver and lead. The Baltic mine was not worked. Development work was done on the Stevens claims.

Eureka district (Hachita,[2] including Sylvanite[3]).—The Hardscrabble Mining Co., during the first four months of the year, shipped ore to the Copper Queen smelter from the Gold Hill group at Sylvanite. This group is opened by a shaft 60 feet deep and by two adits, 240 feet and 120 feet, respectively. From the Eureka district the only other shippers were Siler & Fitch, of Hachita.

Fleming district.—There was no production from this district in 1910.

Fremont district.—Lead-silver ore was shipped from the Eagle mine, which is near the boundary corner between Luna and Grant counties and Mexico.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).[4]—The Lordsburg district is 3 to 8 miles southwest of the town of that name, in central Grant County. Embraced in this district are two camps—Pyramid, at the south end, and Shakespeare or Virginia, at the north. Producing mines in 1910 were the Atwood, Buffalo, Bonnie, Defiance, Dundee, Eighty-Five, Miser's Chest, Nevada, Osceola, Peyton (or Goodsight), Southern, Superior, and Venus (or Viola).

The production from this district in 1910 was 29,220 tons, carrying in gold 2,892.73 fine ounces, valued at $59,798; silver, 130,324 fine ounces, valued at $70,375; copper, 1,627,591 pounds, valued at $206,704; and lead, 19,662 pounds, valued at $865; and with a total value of $337,742, as compared with $129,140 in 1909.

Pinos Altos district.—This district in 1910 made a production from both placer and deep mines of $4,119 in total value, as compared with $7,207 in 1909 and $19,488 in 1908. Both placer and deep-mine yield decreased. Small shipments were made from the Alaskan and the Old Timer mines. The Cleveland and the Forest Queen mines are opened by a tunnel 830 feet long, with 1,153 feet of drifts and raises. There was 500 feet of surface work done, which is reported to have uncovered zinc carbonate ore. Some small lots of the zinc ore were shipped as tests in 1910.

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[1] Interim Report, Chino Copper Company, May 1, 1911.
[2] Lindgren, W., Prof. Paper U. S. Geol. Survey No. 68, 1910, pp. 338-343.
[3] Hill, J. M., idem, pp. 335-338.
[4] Graton, L. C., Prof. Paper U. S. Geol. Survey No. 68, 1910, pp. 332-335.

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Pratt district.—A small shipment of lead ore was made from the Pretty Polly mine.

Red Hill district.—This district is situated near the southwestern corner of New Mexico, and is due southwest of Hachita. Lead ore, carrying also gold, silver, and copper, was shipped to El Paso, Tex., from the Red Hill mine.

San Simon district.—Lead-silver ore was shipped from the Baby and Polly, the Clifford, and the Silver Hill mines, in this district near Steins.

Steeple Rock district.—No production was made in this district in 1910. The American Exploration & Mining Co., owning the Hinkley mines, have opened up the property with 3 shafts 220 feet, 50 feet, and 40 feet deep, and have driven an adit 310 feet long. On the property are a stamp mill, equipped with concentrators, tube mill, agitators, and filter presses. Development work was done on the Alabama mine of the Torreroca Mines Co. The Shamrock mine is opened by a 60-foot drift and a tunnel 300 feet long.

Steins Pass (or Kimball) district.—Siliceous ore, carrying gold and silver, was shipped from the Volcano mine, in this district.

White Signal district.—Small shipments were made from the Bee mine and from the Mary and Mattie mines.

LINCOLN COUNTY.[1]

Both deep and placer mines in Lincoln County increased in output in 1910. The total value of the production in 1910 was $55,849, as compared with $24,499 in 1909. There were 6 producing deep mines. The placer gold, all from Jicarilla, is figured from bullion produced, no record of the actual number of placer claims being available as the placer operations are various and small. The total value of the gold was $1,400. The tonnage from deep mines sold or treated was 10,727 tons in 1910, as compared with 3,633 tons in 1909.

Jicarilla district.—A small but increased production of gold was made in 1910 from placer operations.

Copper ore was opened in the Revenue mine and will be shipped in 1911. No output was made by the Wisconsin Mining & Smelting Co. Some changes have been made in the mill, stamps are being added and a cyanide plant is to be erected. The shaft on the Murphy group of this company is down 400 feet. An adit of 500 feet to strike the shaft is being driven.

Nogal district.—A small shipment of lead ore was shipped from the Adams mine. The Parsons Mining Co. operated its mines and amalgamation mill at intervals from July to November, 1910. The mines are opened by a shaft 74 feet deep, by 400 feet of tunnels and open cut.

White Oaks district.—The production from White Oaks district in 1910 was twice that in 1909. The Wild Cat Leasing Co., on the North and South Homestake mines, was the chief producer. The 20-stamp mill and cyanide plant of the Old Abe Mining Co. was operated on ore from the Old Abe mine. Other operating companies were the Rita Leasing Co. and the White Oaks Leasing Co.

[1] Graton, L. C., Prof. Paper U. S. Geol. Survey No. 68, 1910, pp. 175–184.

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LUNA COUNTY.

The total value of the production of Luna County in 1910 was $14,490, as compared with $36,314 in 1909, and with $6,713 in 1908. The output of lead, the principal metal of the county, was 298,112 pounds, valued at $13,117, a decrease when compared with 682,906 pounds, valued at $29,365, the yield in 1909.

Cooks Peak district.—There were four shippers from Cooks Peak district in 1910. The principal mines in this district are the Summit, operated by the Cooks Peak Mining Co., and the Desdemona, Inez, Monte Cristo, and Othello, leased from the American Smelting & Refining Co. A small lot was shipped from the Old Commodore mine.

Florida district.—Small shipments of lead ore were shipped from this district from the Contention and the West Side mines.

Tres Hermanas district.—The Homestead Mining Co. reported 3 shafts on its property, 120 feet, 110 feet, and 60 feet deep, respectively.

Victorio district.—Lead ore from this district was shipped in 1910 from the Jessie and the Rambler mines.

MORA COUNTY.

The Republic Mines Co., near Lucero, reported no production in 1910, but the prospect of considerable development work for 1911.

OTERO COUNTY.[1]

There were 6 producing deep mines and 2 placers in this county in 1910, the total value of the output being $16,286, as compared with $1,098 in 1909, and $132,454 in 1908.

Sacramento district.—A small lot of lead ore was shipped from the Sacramento mine, in the Sacramento Mountains, in the vicinity of Alamagordo.

Silver Hill (or Jarilla) district.—This district lies near Brice post office, which is 2½ miles northwest of Oro Grande. The principal operating company in 1910 was the By-Chance Copper Co., which shipped copper ore to El Paso in December from the By-Chance mine. Two other small lots were shipped from this district. The Oro Grande smelter was idle in 1910.

A considerable amount of placer gold was produced from the Cotton Top placer by the Texas-Jarilla Placer Co.

Tularosa district.—A small lot of copper ore was shipped from the Simms mine near Mescalero, from a 30-foot shaft. The Tularosa Copper Co., operating the Virginia mine, ran its 100-ton concentrating mill, built during 1910, during parts of two months, producing, with a high ratio of concentration, a copper concentrate carrying a little silver.

RIO ARRIBA COUNTY.

There was no production from this county in 1910.

Near Tres Piedras, in the Bromide district, there was some development work done on the Pay Roll and Hutchison mines. There

[1] Graton, L. C., Prof. Paper U. S. Geol. Survey No. 68, pp. 184–190.

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is a 250-foot shaft on the Pay Roll, and the Hutchison is opened by a 900-foot tunnel. The shaft on the Whale mine, in this district, was sunk 100 feet.

SANDOVAL COUNTY.

In the Cochiti district, near Bland, the Crown Point mine is opened by a 250-foot incline shaft and 800 feet of drifts.

SANTA FE COUNTY.

Santa Fe County produced in 1910 gold, silver, copper, lead, and zinc, the total value of which was $26,173, as compared with $13,445 in 1909, and with $2,034 in 1908. There was an increased production from both placers and deep mines in both the Los Cerrillos and the New Placers (or Golden) districts.

Los Cerrillos district.—The Ortiz Mines Syndicate was the principal placer property in the Los Cerrillos district. The Boston-Cerrillos Mining Co., operating a 150-ton wet concentration mill on the complex ores of the Cash Entry mine, shipped both lead and zinc concentrates.

New Placers district.—Various operators of small placers washed out considerable gold in the New Placers district. Lessees on the Gold Coin and the Gold Standard mines, at San Pedro, shipped the ore to the San Lazarus 20-ton amalgamation and concentration mill, the product being in bullion alone. The smelter of the Santa Fe Gold & Copper Mining Co. was idle in 1910.

SIERRA COUNTY.

The total value of the mine production in 1910 in Sierra County, for both placer and deep mines, was $21,024, of which $11,697 was for gold. The output of silver was 15,778 fine ounces, that of copper 2,448 pounds, and that of lead 11,274 pounds. In 1909 the total value was $29,280. The placer production in 1910 was $584 in gold, with none in 1909.

Black Range district.—This district includes the subdistricts of Chloride, Fluorine, and Kingston. There was no output from the camps in 1910. The U. S. Treasury mine was developed and construction of a 50-ton concentration and cyanide plant was begun. The 10-stamp mill of the Sunset Co. was being remodeled by the Black Range Reduction Co., which proposes to do custom work.

Hermosa district.—This district, near the town of Hermosa, showed a smaller output than in 1909, the Ocean View being the principal mine. The ore from this mine is treated in the company's 20-stamp concentrating mill.

Lake Valley district.—No production was made from this district in 1910.

Las Animas district.—This district, near Hillsboro, produced in 1910, as in 1909, the greater part of the gold of the county. There was an increase in the output of gold, but a decrease in that of silver, lead, and copper. The Ameranza Gold Mining Co. leased the Bonanza mine and the 20-stamp concentration mill on the property. The Statehood Mines Co. operated the Snake and Eureka mines, the ore being treated at the company's 30-stamp amalgamating and concen-

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tration mill. The ore from the Wicks Gulch mine, operated by the Sigma Construction & Development Co. was shipped to smelters. There was a small placer output from the Maher placer and from dry washing by Mexicans.

The Luxenburg placers are to be worked by dry placering, using the Quenner machine.

Pittsburg district.—This district lies in the neighborhood of the town of Las Palomas. A trial lot of copper ore was shipped from the Sagamore Chief mine. There was a small output of placer gold from this district.

SOCORRO COUNTY.

Mine production of gold, silver, copper, lead, and zinc in Socorro County, N. Mex., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	6,603.14	$136,499	15,050.14	$311,114	+ 8,447.00	+$174,615
Silver.....do....	269,061	139,912	662,000	357,480	+ 392,939	+ 217,568
Copper.....pounds..	170,838	22,209	152,284	19,340	− 18,554	− 2,869
Lead.....do....	3,085,328	132,669	3,452,364	151,904	+ 367,036	+ 19,235
Zinc.....do....	12,878,241	695,425	[a]18,013,370	[a] 972,722	+[a]5,135,129	+[a]277,297
Total.....	.....	1,126,714	.....	[a]1,812,560	.....	+[a]685,846

[a] Includes Grant County zinc.

Socorro County in 1910 ranked first in tonnage and in total value of output, yielding gold, silver, copper, lead, and zinc. There was a marked increase in the output of all the metals except copper, which metal is an unimportant constituent of Socorro County ores. The figures for zinc output have been combined with those of Grant County to avoid disclosing individual mine output.

Cooney (or Mogollon) district.—In 1910 there was a material increase in gold and silver production from the Cooney district, which is the source of the greater part of the precious-metal output for the county. The gold yield of this district represents almost two-thirds of the output of this metal of New Mexico and the silver yield over three-fourths of the total silver production. Gold and silver are the only metals produced in the district, the bulk of the production being in the form of bullion, with a smaller part from concentrates.

The Ernestine Mining Co., operating the Last Chance mine, was (as it has been for years) the largest producer of precious metals in New Mexico. The reduction plant at the mine consists of a 30-stamp concentration mill and cyanide plant. The ore is crushed in cyanide solution, concentrated, and re-cyanided. The capacity of the mill is 100 tons per day. The mine is opened by an inclined shaft and an adit. The Socorro Mines Co. ran its 30-stamp concentration and cyanide mill on ore from the Little Fannie mine. The process is crushing in cyanide solution, and concentration by Wilfley tables, the concentrates being shipped to El Paso and the tailings being slimed in tube mills, agitated by Pachuca agitators, and filtered in Burt filters. The Enterprise Mining Co. was in operation the entire

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year on development work, but operated its 70-ton cyanide plant only five weeks during the year. The mine is opened by a vertical shaft 261 feet deep.

Development work was done on the mines of the Alberta Co. The mill and main shaft of the Mogollon Gold & Copper Co. was destroyed by fire in May, 1910. The mines of this company are opened by a shaft 800 feet deep and a tunnel 800 feet long. The mill of the Deadwood mines was not completed in 1910, but was running at full capacity by February, 1911. The ore goes through this mill from crushers to stamps, where the ore is crushed in cyanide solution, over Wilfley tables, and through classifiers. The sands go to leaching vats, and the slimes to the agitation plant and filter presses. The capacity is 60 tons per day, the number of stamps 15. The Gold Dust Mines Co. is developing its properties. No production was reported by the Helen Mining Co.

Magdalena district.—This lead-zinc district is in the central-western part of Socorro County. The chief metal produced in the district is zinc, but there was considerable lead produced, and also copper, silver, and a little gold. The production of zinc was 12,878,241 pounds in 1909 and 3,325,446 pounds in 1908. The output in 1910 was considerably in excess of that of 1909, but the figures have been combined with those of Grant County.

There were six properties in 1910 from which ore was shipped; of these three only were of importance. The Ozark Smelting & Mining Co., owning the Graphic, and the Tri-Bullion Smelting & Development Co., which, in conjunction with lessees, operated the Tri-Bullion group, the Kelly, and the Starlight mines, were the principal operators.

The Tri-Bullion Co.'s annual report for the fiscal year ending October 31, 1910, gives the following figures of output:

> The ores mined and milled during this period aggregated about 20,000 tons, of which the shipments aggregated 14,645 tons of crude ore, zinc and lead concentrates, and iron middlings. The lease on the upper levels, held by Mr. C. T. Brown, has been steadily worked throughout the year, and shipments have amounted to 15,074 tons. The net income from all ore shipped was $270,285.36. Milling operations commenced as an outlet for sulphide ores early in January, 1910, as the last crude sulphide shipped was billed January 14. The wet mill has proved successful in the recovery of lead and the magnetic mill likewise in the separation of the zinc and iron. * * * The capacity of the mills may now be taken at approximately 1,800 tons per month.

The Mistletoe Mining Co in experimental work treated lead-zinc carbonates in a 50-ton concentrator, using Sutton, Steele & Steele dry tables.

The Ozark Smelting & Mining Co. shipped zinc sulphide ore to the company's oxide plant at Coffeyville, Kans. The company also experimented with the flotation process at the mill at Kelly, N. Mex.

Rosedale district.—The camp is 30 miles south of Magdalena. The Rosedale Mining & Milling Co. made a decreased yield in 1910 in bullion. The 50-ton mill on this property was destroyed by fire in September, 1910. The New Golden Bell Mining Co. reported that the mill on their property was idle.

Good Fortune district.—A small lot of copper-lead ore was shipped from this district, east of Engle.

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OREGON.

By CHARLES G. YALE.

PRODUCTION.

The aggregate value of the mine production of gold, silver, and copper in Oregon for the calendar year 1910 was $700,676, as compared with $827,001 in 1909, a decrease of $126,325. The production was derived from 180 mines, of which 116 were placers and 64 deep mines. The number of deep mines producing in 1910 decreased by 2 and the number of placers increased by 20, resulting in a net gain of 18. Of the total output for 1910 the gold yield was 32,870.23 fine ounces, valued at $679,488; the silver yield was 35,978 fine ounces, valued at $19,428; and the copper, 13,861 pounds, valued at $1,760. The total quantity of ore mined and treated in 1910 was 82,132 short tons, an increase of 22,851 tons over the quantity mined and treated in 1909. The siliceous ore sold or treated amounted to 82,064 tons in 1910 (including 12,142 tons of old tailings); in 1909 there were 57,634 tons (including 1,900 tons of tailings)—an increase for 1910 of 24,430 tons. The copper ores in 1910 amounted to 68 tons, as compared with 1,647 tons in 1909, a decrease of 1,579 tons. The average value of siliceous ore per ton in gold and silver in 1910 was $6.42, as compared with $9.87 in 1909 and with $12.49 in 1908. The copper ore sold or treated in 1910 yielded an average value of $4.85 per ton in gold and silver, as compared with $2.92 in 1909. The average recovered value per ton of all metals was $6.42 in the siliceous ore in 1910, as compared with $9.87 in 1909 and with $12.50 in 1908. This reduction in average value per ton accounts largely for the falling off in gold yield for the year 1910.

There were treated in 1910 at gold and silver mills 68,841 tons of ore, yielding $450,275 in gold and 9,307 ounces of silver. In milling the ore $320,304 in gold and 6,215 ounces of silver were recovered by ordinary plate amalgamation, the average value being $4.65 in gold and 5 cents in silver per ton. The concentrates saved from all concentrating ore were 1,988 tons in quantity, yielding $129,971 in gold and 3,093 ounces of silver, or an average value of $65.37 in gold and 84 cents in silver per ton. The average total extraction per ton of crude ore in gold and silver mills, both by amalgamation and in the concentrates, was valued at $6.54 in gold and 7 cents in silver. Crude siliceous ore shipped to smelters amounted to 1,081 tons, containing $47,510 in gold, and 23,895 ounces of silver, an average value per ton of $43.95 in gold and $11.93 in silver. In addition there were 68 tons of copper ore smelted, which yielded $41 in gold, 991 ounces in silver, and 13,861 pounds in copper, valued at $1,760. The copper ores yielded 60 cents in gold, 7.9 ounces in silver, and 204 pounds of copper per ton. There were 12,142 tons of old tailings treated, yielding $10,737 in gold and 1,002 ounces of silver, an average value of 88 cents in gold and 4 cents in silver per ton.

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The production of 1909 and 1910 of gold, silver, copper, and lead in Oregon was as follows:

Mine production of gold, silver, copper, and lead in Oregon in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	37,827.51	$781,964	32,870.23	$679,488	−4,957.28	−$102,476
Silver.....do....	27,827	14,470	35,978	19,428	+ 8,151	+ 4,958
Copper.....pounds..	235,000	30,550	13,861	1,760	− 221,139	− 28,790
Lead.....do....	400	17	.....	.....	− 400	− 17
Total.....	.....	827,001	.....	700,676	.....	− 126,325

GOLD.

The total output of gold in Oregon in 1910 was 32,870.23 fine ounces, valued at $679,488, a decrease of 4,957.28 fine ounces in quantity and of $102,476 in value, as compared with the output of 1909. The largest yield in gold from one county, valued at $401,002, came from Baker County, as has been the case for some years, although it was $16,536 less than in 1909. The next county in rank was Josephine, followed by Jackson, Grant, Malheur, Douglas, and Lane, in the order named. The largest production from deep mines was from Baker County, and of placer mines from Josephine County. The most productive quartz mine in the State was in Baker County, and the most productive placer (hydraulic) was in Josephine County. Sixty-four deep mines produced gold in 1910, 2 less than in 1909. Productive placers numbered 116 in 1910, as compared with 96 in 1909. The placers in 1910 yielded $170,925 in gold, as compared with $221,318 in 1909, a decrease of $50,393. The hydraulic mines in 1910 yielded $118,189 in gold, or $39,174 less than in 1909, and the surface placers, drift, and dredge mines yielded $52,736, or $11,219 less than in 1909. There were in 1910, 64 productive hydraulic mines, 6 dredges, 7 drift, and 39 surface placers.

The mine production of gold in fine ounces, with classification of ores and increase or decrease for 1909 and 1910, is as follows:

Mine production of gold in Oregon in 1909 and 1910, by kinds of ore, in fine ounces.

Year.	Placers.	Deep mines.			Grand total.	
		Siliceous ore.	Copper ores.	Total.	Quantity.	Value.
1909.....	10,706.26	26,893.89	227.36	27,121.25	37,827.51	$781,964
1910.....	8,268.50	24,599.75	1.98	24,601.73	32,870.23	679,488
Increase (+) or decrease (−).	−2,437.76	−2,294.14	−225.38	−2,519.52	−4,957.28	−102,476

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The gold production from different kinds of mines, by counties, for 1910, is given in the following table:

Source of gold production in Oregon, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ore.	Copper ores.	Total.	
Baker	545.48	18,851.01	1.98	18,852.99	19,398.47
Coos	10.93	7.64	.....	7.64	18.57
Curry	156.01	.....	.....	.....	156.01
Douglas	94.38	348.11	.....	348.11	442.49
Grant	871.77	879.46	.....	879.46	1,751.23
Harney	11.12	.....	.....	.....	11.12
Jackson	1,834.67	219.62	.....	219.62	2,054.29
Josephine	4,197.74	3,060.83	.....	3,060.83	7,258.57
Lane	.....	196.12	.....	196.12	196.12
Malheur	485.93	1,026.95	.....	1,026.95	1,512.88
Wheeler	60.47	10.01	.....	10.01	70.48
Total	8,268.50	24,599.75	1.98	24,601.73	32,870.23
Decrease	2,437.76	2,294.14	225.38	2,519.52	4,957.28

The following table shows the source of placer gold in Oregon, by counties, in 1910:

Source and value of placer gold in Oregon in 1910, by counties.

County.	Hydraulic.	Drift.	Dredging.	Surface placers.	Total.
Baker	$5,269	$1,577	.....	$4,430	$11,276
Coos	.....	.....	.....	226	226
Curry	1,393	.....	.....	1,832	3,225
Douglas	1,571	.....	.....	380	1,951
Grant	10,985	1,850	$2,500	2,686	18,021
Harney	.....	.....	.....	230	230
Jackson	7,576	.....	30,010	340	37,926
Josephine	81,871	20	1,500	3,384	86,775
Malheur	8,274	.....	.....	1,771	10,045
Wheeler	1,250	.....	.....	.....	1,250
Total	118,189	3,447	34,010	15,279	170,925

The following table shows the increase or decrease in gold production in Oregon, in 1910, by counties:

Increase or decrease in gold production of Oregon, in 1910, by counties.

County.	Increase.	Decrease.
Baker	.....	$16,586
Coos	.....	48
Crook	.....	1,000
Curry	.....	5,407
Douglas	$7,353	.....
Grant	.....	5,127
Harney	.....	585
Jackson	.....	57,752
Josephine	1,051	.....
Lane	.....	10,118
Malheur	.....	11,079
Wheeler	.....	3,228
Total	8,404	110,880
Net decrease in 1910	102,476	

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SILVER.

The yield of silver in Oregon in 1910 aggregated 35,978 fine ounces, valued at $19,428, an increase of 8,151 fine ounces in quantity and of $4,958 in value, as compared with the production of 1909. Baker County made in 1910 the largest silver output, 29,835 fine ounces, valued at $16,111, as compared with 19,514 ounces, valued at $10,147, in 1909. No other county in the State produced over 2,322 ounces in 1910. The placer mines of Oregon yielded 1,239 fine ounces in 1910, as compared with 2,054 ounces in 1909. The quartz mines yielded 34,739 fine ounces in 1910, valued at $18,759; of this, 535 ounces, valued at $289, came from copper ores, all the remainder being from siliceous ore.

The source of silver, by kinds of ore and by counties, in 1910 is shown in the following table:

Source of silver production in Oregon, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ore.	Copper ores.	Total.	
Baker	117	29,183	535	29,718	29,835
Coos	4	.....	.....	.....	4
Curry	18	.....	.....	.....	18
Douglas	24	74	.....	74	98
Grant	148	2,174	.....	2,174	2,322
Harney	2	.....	.....	.....	2
Jackson	298	780	.....	780	1,078
Josephine	517	448	.....	448	965
Lane	.....	67	.....	67	67
Malheur	98	1,476	.....	1,476	1,574
Wheeler	13	2	.....	2	15
Total	1,239	34,204	535	34,739	35,978
Increase (+) or decrease (—)	—815	+8,658	+308	+8,966	+8,151

COPPER.

The mine production of copper in Oregon in 1910 was only 13,861 pounds, valued at $1,760, from 68 tons of ore. This ore also carried gold to the value of $41, and 535 fine ounces of silver. In 1909 Josephine County produced 235,000 pounds of copper, valued at $30,550, but there was no copper output from this county in 1910, which accounts for the material reduction in copper production for the year, amounting to 221,139 pounds in quantity and to $28,790 in value.

LEAD.

Although there was a nominal mine output of lead in Jackson County in 1909, there was no production of lead from that county nor from the entire State in 1910.

MINING INDUSTRY IN OREGON IN 1910.

Southwestern and northeastern Oregon form two distinct mining regions which differ in character of deposits and ores. The mines in southwestern Oregon form an extension of the California gold belt.

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The counties in this region of Oregon are Benton, Coos, Curry, Douglas, Jackson, Josephine, and Lane. There was no production from Benton County in 1910, but the other counties named made a combined gold production of $209,324, which was a decrease of $64,921 from the output of 1909. The production of placer gold from this region in 1910 was valued at $130,103, or a decrease of $55,149, and the gold production from the deep mines was $79,221, a decrease of $9,772. The silver production in southwestern Oregon in 1910 was 2,230 fine ounces, valued at $1,204. Of the total decrease in gold in this section 85 per cent was due to the falling off in placer production and 15 per cent to reduction in quartz gold output. In 1909 there was a decrease of $8,232 in placer gold, and in 1908 there was a decrease of $46,458 in placer gold, showing that the gold yield from placer operations is annually declining. The decrease of gold yield from deep mines was $9,772 in 1910, $63,670 in 1909, and $99,376 in 1908.

Northeastern Oregon comprises the counties of Baker, Crook, Grant, Harney, Malheur, Umatilla, Union, Wallowa, and Wheeler, among which is the most productive county in the State. The combined gold yield of this region in 1910, omitting Crook, Umatilla, Union, and Wallowa, with no output, was $470,164, a decrease of $37,555. The placer gold yield was $40,822 in 1910, an increase of $4,756. The lode mines yielded $429,342 in gold, a decrease of $42,311. The silver production of northeastern Oregon in 1910 was 33,748 fine ounces, valued at $18,224. The placer gold yield of these counties in 1909 was $43,043 less than in 1908, and the quartz gold yield $63,670 less. The placer gold yield in 1908 was $12,355 less than in the year 1907, and the lode mine gold $105,784 less. These figures show that both quartz and placer mines in northeastern Oregon, as well as those in southwestern Oregon, are gradually declining in gold yield.

The subdivision of tonnage and production of gold and silver in Oregon in 1910, according to methods of treatment, is shown in the following table:

Subdivision of tonnage and production of gold and silver in Oregon, in 1910, according to methods of treatment, by counties.

County.	Ore to gold and silver mills.			Concentrates treated.		
	Tonnage.	Gold (value).	Silver (fine ounces).	Tonnage.	Gold (value).	Silver (fine ounces).
Baker	43,935	$225,505	3,639	1,860	$121,510	1,818
Coos	5	158	.....	.....	.....	.....
Douglas	2,310	7,196	74	.....	.....	.....
Grant	2,341	12,381	1,815	30	851	78
Harney	.....	.....	.....	.....	.....	.....
Jackson	1	30	.....	.....	.....	.....
Josephine	16,390	55,807	380	3	1,905	54
Lane	807	4,054	67	.....	.....	.....
Malheur	3,031	14,966	239	95	5,705	1,143
Wheeler	21	207	1	.....	.....	.....
Total	68,841	320,304	6,215	1,988	129,971	3,093
Average value per ton	.....	$4.65	$0.05	.....	$65.37	$0.84

Average recovery value (per ton) from both bullion and concentrates: Gold—$6.54; silver—$0.07.

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Subdivision of tonnage and production of gold and silver in Oregon, in 1910, according to methods of treatment, by counties—Continued.

County.	Crude ore to smelter.			Old tailings treated.		
	Tonnage.	Gold (value).	Silver (fine ounces).	Tonnage.	Gold (value).	Silver (fine ounces).
Baker	1,028	$34,830	23,335	11,300	$7,881	926
Coos						
Douglas						
Grant	32	2,092	206	842	2,856	76
Harney						
Jackson	62	4,510	780			
Josephine	25	5,561	15			
Lane						
Malheur	2	558	94			
Wheeler						
Total	1,149	47,551	24,430	12,142	10,737	1,002
Average value per ton		$41.38	$11.48		$0.88	$0.04

The total tonnage, by kinds of ore sold or treated, in each county in Oregon in 1910 is shown in the following table:

Subdivision of tonnage of ore sold or treated in Oregon in 1910, by counties, in short tons.

County.	Siliceous ore.	Copper ores.	Total ore.
Baker	56,195	68	56,263
Coos	5		5
Douglas	2,310		2,310
Grant	3,215		3,215
Jackson	63		63
Josephine	16,415		16,415
Lane	807		807
Malheur	3,033		3,033
Wheeler	21		21
Total	82,064	68	82,132
Increase (+) or decrease (−)	+24,430	−1,579	+22,851
Average value per ton in gold and silver	$6.42	$4.85	$6.43

The following table gives the number of producing mines, classified according to their chief product, in the counties of Oregon in 1910:

Number of mines, classified by chief product, in Oregon in 1910, by counties.

County.	Gold placer mines.					Deep mines.			Total producing mines.
	Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Copper.	Total.	
Baker	11		5	13	29	24	1	25	54
Coos				3	3	1		1	4
Curry	2			6	8				8
Douglas	3			2	5	4		4	9
Grant	0	1	1	2	13	14		14	27
Harney				2	2				2
Jackson	9	3		1	13	3		3	16
Josephine	26	2	1	7	36	10		10	46
Lane						4		4	4
Malheur	2			3	5	2		2	7
Wheeler	2				2	1		1	3
Total	64	6	7	39	116	63	1	64	180

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The following table shows the mine production of gold, silver, and copper in Oregon in 1910, by counties, with the tonnage:

Production of precious metals in Oregon in 1910, by source, and production of copper, by counties.

County.	Ore treated.	Quartz gold.		Placer gold.		Total gold.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*		*Fine ounces.*	
Baker	56,263	18,852.99	$389,726	545.48	$11,276	19,398.47	$401,002
Coos	5	7.64	158	10.93	226	18.57	384
Curry				156.01	3,225	156.01	3,225
Douglas	2,310	348.11	7,196	94.38	1,951	442.49	9,147
Grant	3,215	879.46	18,180	871.77	18,021	1,751.23	36,201
Harney				11.12	230	11.12	230
Jackson	63	219.62	4,540	1,834.67	37,926	2,054.29	42,466
Josephine	16,415	3,060.83	63,273	4,197.74	86,775	7,258.57	150,048
Lane	807	196.12	4,054			196.12	4,054
Malheur	3,033	1,026.95	21,229	485.93	10,045	1,512.88	31,274
Wheeler	21	10.01	207	60.47	1,250	70.48	1,457
Total	82,132	24,601.73	508,563	8,268.50	170,925	32,870.23	679,488

County.	Quartz silver.		Placer silver.		Total silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Fine oz.*		*Pounds.*		
Baker	29,718	$16,048	117	$63	29,835	$16,111	13,861	$1,760	$418,873
Coos			4	2	4	2			386
Curry			18	10	18	10			3,235
Douglas	74	40	24	13	98	53			9,200
Grant	2,174	1,174	148	80	2,322	1,254			37,455
Harney			2	1	2	1			231
Jackson	780	421	298	161	1,078	582			43,048
Josephine	448	242	517	279	965	521			150,569
Lane	67	36			67	36			4,090
Malheur	1,476	797	98	53	1,574	850			32,124
Wheeler	2	1	13	7	15	8			1,465
Total	34,739	18,759	1,239	669	35,978	19,428	13,861	1,760	700,676

PRODUCTION BY COUNTIES.

BAKER COUNTY.

The total value of the metals mined in Baker County in 1910 was $418,873, as compared with $427,685 in 1909, a decrease of $8,812 for the year 1910. The yield in gold, valued at $401,002 in 1910, was $16,536 less than in 1909, and the yield of silver was 29,835 fine ounces, valued at $16,111 in 1910, an increase of 10,321 ounces in quantity and of $5,964 in value. There was also a yield of 13,861 pounds of copper, valued at $1,760, in 1910. No copper was mined in the county in 1909. There were 54 producing mines in the county in 1910, as compared with 42 in 1909. The placers numbered 29, of which 11 were hydraulic, 5 drift, and 13 surface or sluicing properties. These placers combined yielded $11,276 in gold, and 117 ounces in silver in 1910, as compared with $16,470 in gold and 183 ounces in silver in 1909. The total number of deep mines from which product was reported was 24 and their output of siliceous ore was 56,195 tons in 1910, or 23,674 tons more than in 1909. The gold yield of this ore

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was valued at $389,685, and the silver yield was 29,183 fine ounces, valued at $15,759. The average value of the ores per ton was $6.93 in gold and 3 cents in silver, a total of $6.96 per ton in 1910, as compared with $12.64 in gold and 31 cents in silver, a total of $12.95 per ton in 1909. Of the total of 56,195 tons of siliceous ore, 43,935 tons were treated at gold and silver mills and yielded $225,505 in gold and $1,965 in silver (3,639 ounces) on the plates, an average value of $5.13 per ton in gold and 4½ cents in silver. From the 43,935 tons of milling ore were derived 1,860 tons of concentrates, yielding $121,510 in gold and 1,819 ounces of silver, a total value of $122,492, or an average of $65.86 per ton. The tonnage of concentrates was larger in 1910 than in 1909 by 142 tons, but the average value per ton was $22.72 less. Crude ore was shipped to smelters to the amount of 1,028 tons and yielded $34,830 in gold, 23,335 fine ounces of silver, and 13,861 pounds of copper, a total value for the smelting ores of $49,191, or an average of $47.85 per ton. In addition to this there were 11,300 tons of old tailings treated, yielding $7,881 in gold and 926 ounces of silver, an average value of 74 cents per ton.

Baker district.—The mines at Baker City and Virtue are included in this district. There were 6 producing mines reported in 1910, which yielded $37,052 in gold and 22,819 ounces of silver, a total value of $49,372. The most productive deep mine was that of the Highland Gold Mines Co., which has no reduction works but ships its crude ore to a smelter for treatment. None of the placers are worked on an extensive scale, and all of them are sluicing properties.

Cornucopia district.—The 4 deep mines operating productively in this district are the Cornucopia, the Queen of the West, the Ross, and the W. P. C. Co. Their combined production was 30,798 tons of ore, which yielded $113,258 in gold and 4,470 ounces of silver. The Cornucopia mine has a 20-stamp mill with concentrators and a cyanide plant. The property is developed by a 400-foot inclined shaft and several adits. The Queen of the West Mines Co. has a 10-stamp mill with concentrators. The W. P. C. Co. has a 35-ton cyanide plant for handling tailings.

Cracker Creek district.—This district includes the mines at Bourne and Sumpter, of which there are 6 producing deep mines and 2 placers. At Bourne are the Climax Group, the Northwestern, the South Pole Consolidated, and the Taylor, all deep mines; and at Sumpter are the deep mines of the Columbia Gold Mining Co. and the Belle of Baker, as well as the Buck Gulch and the Brodie placers. The Climax group is developed by a tunnel 800 feet long and has a 20-ton amalgamating and concentrating mill. The mine was operated by the company up to July 20, 1910, when it was placed under bond and lease. The South Pole is equipped with a 5-stamp amalgamating and concentrating mill. The Belle of Baker has a Bryan mill for reducing its ores. The Columbia Gold Mining Co., which operates the most productive mine in Oregon, has a 20-stamp amalgamating and concentrating mill and a 100-ton cyanide plant. It has a shaft 900 feet deep and several tunnels.

Mormon Basin district.—The 4 deep mines and 2 placers in this district from which production was reported in 1910 are located at or near Rye Valley. The deep mines are the Blue Jay and the Morning Star, properties of the Commercial Mining Co., the May Queen, and the Justis. The combined output of the mines in the district in 1910

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was $71,713 in gold, and 602 ounces of silver, with a total value of $72,038. The placers are the Deer Creek and the Rye Valley mines, both operated by the hydraulic system on gravels of an ancient river bed. The most important of the deep mines is that of the Commercial Mining Co., where there is a 50-ton stamp mill with concentrators. The mine has an inclined shaft 240 feet deep and a 400-foot tunnel. About 1,600 feet of development work was done during the year 1910, and the mill was only operated at half its capacity while exploration and development was being carried on. The May Queen is equipped with a 5-stamp mill.

Other districts.—At Bridgeport there are 7 productive placers, 3 of which are hydraulic, 2 drift, and 2 sluicing mines. These are the Bartholomew, Clark Creek, John Dix, Johnson, Surprise, Pine Creek, and some smaller ones. Their combined output was $2,500 in gold and silver. At Connor Creek the Connor Creek Mining & Milling Co. operated its 20-stamp mill only a short time, as the mine was closed down most of the year. The Camp Bird and the Gardner hydraulic mines are at the same place. At Durkee, Lost Basin district, there are 1 productive deep mine and 1 placer. At Geiser, in Bonanza district, the Consolidated Bonanza is the only productive mine, a deep one. At Greenhorn the following deep mines are producing in a small way: Banzette, Golden Eagle, Kansas Girl, Man-of-War, and Royal White. At Hereford are the White Cloud and the Cow Creek hydraulic mines, the Bull Dog and the Old Channel drift mines, and the Tom-Tom sluicing mine; these had in 1910 a combined output of $1,654 in gold and silver. At Homestead the Iron Dyke Copper Mining Co. is shipping copper ores, carrying also some gold and silver. At Richland there is one small producing placer, and at Robinette there is another. At Sparta are the Rattlesnake and the Sparta placer mines, both sluicing properties. At Weatherby the Dan group is the only productive deep mine, and the Fostering drift mine the only placer.

COOS AND CURRY COUNTIES.

Coos County showed a slight reduction in its gold output for 1910, and Curry County showed a lessened output of $5,407. The only deep mine producing in Coos County was the Washington, in Johnson Creek district. Of placers, the Bullard and the Rustler and Flanagan Bar are small sluicing properties. In Curry County no output was reported from deep mines, the entire production having been derived from placers. At Corbin the Kalamazoo is a small sluicing property. At Selma, Chetco district, are the Golden Dream and the Higgins, both hydraulic mines. The Eureka Creek mine is at Marial, in Mule Creek district. There are several beach sand mines at Port Orford, in Cape Blanco district. The total gold and silver production of the two counties (aside from $518 worth of platinum) was valued at $3,621.

DOUGLAS COUNTY.

Douglas was one of the two counties of Oregon which showed an increase in gold production in 1910, the increase amounting to $7,353. Four deep mines and 5 placers were productive. Of the deep mines the Gold Leaf is at Booth, on Starvout Gulch, a tributary of Cow

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Creek district. The Kelso Gold Mining & Milling Co. has a 5-stamp amalgamating and concentrating mill. The Black Diamond, at Glendale, in Cow Creek district, has its ore worked by arrastre. The Continental Mines Co., at Nugget, has no reduction works, and the ore is shipped to the smelter at Tacoma, Wash. Of the placer mines of the county, the Boulder and the O'Shea hydraulic mines are at Booth, and the Cunes Creek hydraulic mine is at Glendale. There are also small sluicing mines at Glendale and Dillard. From this county there were 2,310 tons of ore mined and treated in 1910, yielding $7,196 in gold and 74 ounces of silver, valued at $40. The placers yielded $1,951 in gold and 24 ounces of silver, valued at $13. The total yield of the county in gold and silver was valued at $9,200.

GRANT AND HARNEY COUNTIES.

The production of Grant County in 1910 was $36,201 in gold and 2,322 fine ounces of silver, valued at $1,254, a total value of $37,455. The deep mines produced 3,215 tons of ore, yielding $18,180 in gold and 2,174 fine ounces of silver, valued at $1,174; and the placers yielded $18,021 in gold and 148 ounces of silver, valued at $80. The total gold yield in 1910 was $5,127 less than in 1909. At Austin, in Poker Flat district, are the Belmont and the Goldfield quartz mines, both small producers, and the Poker hydraulic mine. At Beach Creek, in the same district, the Black Butte Mining Co. has a Merrill roller mill, but no ores were mined during the year, the production having come from working over old tailings. This same company operates productively a hydraulic mine, 2 miles from Beach Creek post office. In Canyon Mountain district, at Canyon City, 1 deep mine and 4 placers produced $10,438 in gold and 81 ounces of silver, valued at $44. The deep mine is operated by the Canyon Mountain Mining Co., and only specimen ore was worked in a hand mortar. The placers in the district are all worked by the hydraulic process, and are the Mule Gulch, Caledonia, Marysville, and Quartz Gulch. At Galena there is 1 productive hydraulic and 1 drift mine. At Granite the only deep mine is the Garrett, and the Gold Center dredge is at the same place. The Onion Creek hydraulic mine is also at Granite. At Greenhorn the Morning and the Myrtle deep mines are productive. The Morning has a 5-foot Bryan mill and concentrator and is developed by a 1,000-foot tunnel and also 250 feet of drifts. The Myrtle has a 3-stamp mill.

Greenhorn is in Baker County, but is the nearest post office to these mines. The Equity Copper and Gold Mining Co. operates the Colorado mine at Prairie City, in Quartzburg district. The lower grade ore only is milled in a 5-stamp mill, the richer ore being shipped to a smelter. The Saw Mill Gulch hydraulic mine is in the same district. The Red Boy Mines Co. in Red Boy district was a small producer in 1910. At Susanville are the following quartz mines: Gold Bug, Kennerly, Heilig, Maisie Ridge, and a few small properties.

In Harney County there are only two producing mines, both small sluicing properties at Harney City.

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JACKSON COUNTY.

In Jackson County there are 3 deep mines productive and 13 placers; of the latter there are 9 hydraulic mines, 3 dredges, and 1 sluicing mine. In 1910 the county produced $42,466 in gold and 1,078 ounces of silver valued at $582. The decrease in gold production in 1910, amounting to $57,752, is the most material of any county in the State. This is largely accounted for by the decreased yields in 1910 of the principal quartz mine in the county and of the principal dredge mine. There were only 63 tons of ore treated in the county in 1910, and the placers yielded $37,926 of the gold produced in Jackson County during the year. The deep-mine operators were the Opp Mining Co. at Gold Hill, the Sterling Gold Quartz Mining Co. at Medford, and the Pearl Mining Co. at Trail. At Applegate, the Johnson is a small hydraulic mine. At Draper, Foots Creek district, the Mattie hydraulic mine was productive. At Gold Hill, in the same district, are the Carr Bros. and the Glen Ditch hydraulic mines, and the dredges of the Champlin Dredging Co. and of the Electric Gold Dredging Co. The Black Channel and the Boys are both hydraulic mines at Rock Point, in Foots Creek district. At Woodville, also in the same district, is the Lance Bros. dredge. The Foots Creek district mines combined made a yield in 1910 of $38,574 gold and of 1,033 ounces of silver, valued at $558, from the mines named. It is the most important of the productive districts of the county. At Jacksonville are the Forest Creek and the Spaulding hydraulic mines, and at Weimer is the hydraulic mine of the Sykes Creek Mining Co.

JOSEPHINE COUNTY.

The total output of Josephine County in 1910 was valued at $150,569, as compared with $180,402 in 1909, a decrease of $29,833. There was an output of $30,550 of copper mined in this county in 1909, whereas there was no production of copper in 1910. In gold there was an increase in the county of $1,051 in 1910 as compared with 1909, and a decrease of 679 ounces of silver, valued at $334, for the same period. The 10 deep mines in the county in 1910 produced 16,415 tons of ore, which yielded 3,060.83 fine ounces of gold, valued at $63,273, and 448 ounces of silver, valued at $242. The 36 placers comprise 26 hydraulic mines, 2 dredges, 1 drift, and 7 surface or sluicing mines. Combined, these mines produced 4,197.74 fine ounces of gold, valued at $86,775, and 517 ounces of silver, valued at $279. The total gold product of the county in 1910 was valued at $150,048, and its silver output was 965 ounces, valued at $521. The placer yield of the county exceeded the deep-mine gold yield by $23,502. All the ore produced in the county was treated at gold and silver mills, with the exception of 25 tons, which were shipped to the smelter. The output of crude ore in the county in 1910 exceeded that of 1909 by 10,453 tons. In Althouse or Sucker Creek district, at Holland post office, the 2 deep and the 5 placer mines made a combined yield of $3,577 in gold and silver. The Brooklyn is a pocket mine and only worked in "bunches." There is a 2-stamp mill on the property. The January has its ore worked in an arrastre run by water power. The Goldsby is a hydraulic mine, the Rynski a drift mine, and the Little Homestead, the Surprise, and

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the Trevor are sluicing properties. The American Belle Mining Co. in this district has acquired an area of gravel claims along the creek for a distance of about 10,000 feet and is bringing in water under a high head. A 3-mile flume was being constructed during 1910.

The Mountain Lion mine, being operated in Davidson district, is developed by 1,920 feet of tunnels and drifts. It is equipped with a 5-stamp mill, using electrolytic chlorination and amalgamation for treatment of the ore. In Galice district there are 4 producing deep mines and 9 placers, the total output from which in 1910 was $26,769 in gold, and 85 ounces of silver, valued at $46. The deep mines producing were the Gold Road, Oriole, Sugar Pine, and the Nesbit group. The Sugar Pine has a 10-stamp mill. The placers in the district are the Rogue River, Scandanavian, Dean, Gold Bar, Galice Placer mines, and the Old Channel, all hydraulic properties, and the Cheldelin, Copsey, and several small sluicing mines. The Old Channel was the largest producer. The Rogue River Dredging Co. worked with a steam shovel at first and has a drag line bucket dredge under construction, not completed in 1910. In Grave Creek district, at Placer and at Leland, the total yield from 2 deep mines and 4 placers, was $57,156 in gold, and 450 ounces of silver, valued at $243; it is the most productive district in the county. The Greenback Gold Mining Co. and the Martha Mining Co. own the quartz properties at Placer. At the Greenback there is a 40-stamp amalgamating and concentrating mill, and the ores of the Martha are worked at this same mill. The Columbia Mines Co. at Placer, in this district, is operating a very productive hydraulic mine. At Leland, in this same district, are the Archer, Crackerjack, and McMickle hydraulic mines. In Josephine district, at Kerby, 5 hydraulic mines produced $3,549; these mines are the Canyon Creek, the Gold Lead group, the Flint Lock, the Wilson & Anderson, and the Illinois & Josephine.

In Picket Creek district, at Merlin, are 2 producing hydraulic mines, the Big Four and the Flanagan & Emerson. At Waldo the 4 hydraulic mines are the Allen Gulch, the Davis, the Deep Gravel, and the Fry Gulch, with a combined production for the district of $32,135 in gold and of 133 ounces of silver, valued at $72. The Davis is the most productive placer in the State. Since the close of the year 1910 these four mines have been transferred to the Waldo Consolidated Gold Mining Co. of Oregon, which is now operating them under one ownership. At Williams there is only 1 producing mine, the Williamsburg hydraulic property. In Winona, or Jump Off Joe district, are 3 hydraulic mines, the Cook & Howland, the Sexton, and the Swatiska. In Wolf Creek district, at Wolf Creek and Golden, are 1 deep mine and 3 placers. The quartz mine is that of the Glendale Mill and Mining Co., at Golden, which is developed by a shaft, 135 feet deep, and a tunnel 425 feet long; the property is equipped with a 5-stamp amalgamating mill, with concentrator and a cyanide plant. The Jason or Marshall hydraulic mine is near Wolf Creek, and the Ruble and the Copper Knob placers are at Golden.

LANE COUNTY.

In Lane County there were only 4 productive mines, all deep ones, in Blue River and Bohemia districts. The total product of the county was 807 tons of ore, yielding $4,054 in gold, and 67 ounces of

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silver, valued at $36. The Blue Bird Mining Co. owns the Red Star and the Red Cloud mines at Blue River, which are developed by 3 tunnels 600 feet long. The mines are equipped with a roller mill with a capacity equal to 10 stamps. In Bohemia district, at Bohemia, the West Coast Mines Co. has a 30-stamp mill, but it was not operated in 1910. The Sweepstake and the Cline are producers at Cottage Grove, also in Bohemia district. The Sweepstake has a 2-stamp mill. For the year 1910, Lane County showed a falling off in gold yield of $10,118, owing to the fact that operators of the most important deep mine milled no ore in 1910.

MALHEUR AND WHEELER COUNTIES.

The total yield of Malheur County for 1910 from 2 deep and 5 placer mines was $31,274 in gold and 1,574 ounces of silver, valued at $850. This was a decrease of $11,079 in gold. In Malheur district the Black Eagle Mining Co. has ceased to operate its quartz property. The placers are the Quartz Gulch hydraulic and a few sluicing mines. In Mormon Basin district is the Colt Bros. hydraulic, and the Anders and Head sluicing mines. The only productive deep mine in the district is that of the Humboldt Gold Mines Co., at Rye Valley, which is developed by a vertical shaft 200 feet deep and a tunnel 2,000 feet long. The property is equipped with a 10-stamp amalgamating and concentrating mill.

Wheeler County made a total production of $1,457 in gold and of 15 ounces of silver, valued at $8, in 1910, the decrease in gold yield being $3,228. There are 1 small producing deep mine in the county and 2 hydraulic mines, all in Spanish Gulch district.

SOUTH DAKOTA.

By Charles W. Henderson.

PRODUCTION.

In 1910 the production of gold, silver, and lead in South Dakota was valued at $5,467,031 and was derived from 18 deep mines and 8 placers. This was a decrease of $1,227,282, as compared with the output of 1909, and of $2,323,157, as compared with that of 1908. Almost 99 per cent of the total value was that of the gold output, which was 261,334.18 fine ounces, valued at $5,402,257, a decrease of 56,868.64 fine ounces, valued at $1,175,579. The yield of silver decreased in about the same proportion, the production of that metal being 118,800 fine ounces, a decrease of 75,473 fine ounces, as compared with 194,273 fine ounces in 1909. Lead recovered from South Dakota ores in 1910 amounted to 14,136 pounds, as against 1,512 pounds in 1909 and 23,046 pounds in 1908. No ores carrying copper were treated in 1910. Copper ore treated in 1909 contained 118,385 pounds of copper.

The production of gold from 8 placers was 143.77 fine ounces, as compared with 57.03 fine ounces from 5 placers in 1909.

The total ore mined and treated in 1910 was 1,523,929 short tons, with an average content per ton of 0.1714 ounce, or $3.543 in gold, as compared with 1,704,141 short tons averaging $3.859 in 1909, and with 1,929,549 short tons averaging $3.963 in 1908.

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There were 1,516,339 tons treated in the mills of the State, yielding, as bullion, $5,234,211 in gold and 101,922 fine ounces of silver, valued at $55,038, a total value of $5,289,249, or an average recovery per ton of $3.451 in gold and of $0.036 in silver. Crude ore to smelters amounted to 7,589 tons, with an average content in gold of 1.0457 ounces, or $21.617 per ton, and averaging $22.80 per ton in value of both gold and silver.

Mine production of gold, silver, copper, and lead in South Dakota in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	318,202.82	$6,577,836	261,334.18	$5,402,257	−56,868.64	−$1,175,579
Silver.....do....	194,273	101,022	118,800	64,152	− 75,473	− 36,870
Copper.....pounds..	118,385	15,390	.....	.....	− 118,385	− 15,390
Lead.....do....	1,512	65	14,136	622	+ 12,624	+ 557
Total.....	.....	6,694,313	.....	5,467,031	.....	− 1,227,282

The Homestake mines and mills were closed in November, 1909, to avoid a strike, and were not in full operation until March 3, 1910. Men were brought in from outside districts at the close of the year 1909, and during the first four or five months of 1910 there were many new men engaged to take the place of the union men. The operations of many of the other larger companies were affected by the labor conditions and most of the mills were idle during the spring months. In January, 1910, the Homestake Mining Co., with 12 other companies, declared for nonunion labor conditions and the establishment of the card system.

The following table shows the production of gold in South Dakota since the discovery of gold in that State in 1875:

Production of gold in South Dakota since 1875.

1876[a]	$1,200,000	1895[d]	$3,869,500
1877[a]	2,000,000	1896[d]	4,969,800
1878[a]	2,250,000	1897[d]	5,694,900
1879[a]	2,500,000	1898[d]	5,699,700
1880[b]	3,305,843	1899[d]	6,469,500
1881[b]	4,000,000	1900[d]	6,177,600
1882[b]	3,300,000	1901[d]	6,479,500
1883[b]	3,200,000	1902[d]	6,965,400
1884[b]	3,300,000	1903[d]	6,826,700
1885[b]	3,200,000	1904[e]	7,363,977
1886[b]	2,700,000	1905[e]	6,989,492
1887[b]	2,400,000	1906[e]	6,841,469
1888[b]	2,600,000	1907[e]	4,138,189
1889[b]	2,900,000	1908[e]	7,657,376
1890[b]	[c] 3,200,000	1909[e]	6,577,836
1891[b]	3,550,000	1910[e]	5,402,257
1892[b]	3,700,000		
1893[d]	4,006,400	Total	155,303,594
1894[d]	3,868,155		

[a] Black Hills, S. Dak., by the Black Hills Mining Men's Association, 1904.
[b] Emmons, S. F., Progress of the precious-mineral industry in the United States since 1880; Mineral Resources United States for 1892, U. S. Geol. Survey, 1893, p. 71. Estimate of the Director of the Mint.
[c] A canvass of the mines by the Eleventh Census gives $3,091,137.
[d] Mineral Resources United States, U. S. Geol. Survey. Estimated by the Director of the Mint.
[e] Mineral Resources United States, U. S. Geol. Survey. Collected by the United States Geological Survey from the mines.

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Source of gold and silver production in South Dakota in 1910.

Source.	Number of mines.	Tonnage.	Gold.		Silver.		Total.
			Quantity.	Value.	Quantity.	Value.	
Deep mines:		*Short tons.*	*Fine ounces.*		*Fine ounces.*		
Siliceous ore	17	1,523,868	261,158.77	$5,398,631	117,333	$63,360	$5,461,991
Lead ore	1	61	31.64	654	1,441	778	1,432
	18	1,523,929	261,190.41	5,399,285	118,774	64,138	5,463,423
Placer mines	8	.....	143.77	2,972	26	14	2,986
Total	26	1,523,929	261,334.18	5,402,257	118,800	64,152	5,466,409

REVIEW BY COUNTIES.

CUSTER COUNTY.

There was no production in Custer County in 1910.

Considerable development work was done by lessees on the Empire-Baker mine, near Custer. Assessment work was done on the Granite Reef mine. Development work was also done on the properties of the Hartwell Mining Co., the Ruberta Mining & Milling Co., and on the Ruby group.

LAWRENCE COUNTY.

Mine production of gold, silver, copper, and lead in Lawrence County, S. Dak., in 1909 and 1910.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1909	317,418.75	$6,561,628	191,044	$99,343	3,977	$517	1,512	$65	$6,661,553
1910	260,295.96	5,380,795	118,716	64,106	.....	.....	14,136	622	5,445,523
Increase (+) or decrease (−)	−57,122.79	−1,180,833	−72,328	−35,237	−3,977	−517	+12,624	+557	−1,216,030

The output of metals in Lawrence County in 1910 was $5,380,795 in gold, 118,716 fine ounces of silver, and 14,136 pounds of lead, with a total value of $5,445,523, of the State total for the year of $5,467,031. In this county are all the important mines of the State, including the Homestake, which produces 75 per cent and more of the State output.

During 1910 there were 1,522,986 short tons of ore treated (mostly siliceous) from 15 deep mines, with an average value per ton in gold of $3.53 and in silver of $0.042, as compared with 16 mines in 1909, with an output of 1,699,260 short tons and an average value per ton of $3.86 in gold and of $0.06 in silver, and as compared with 13 mines in 1908 with an average value per ton of $3.96 in gold and of $0.07 in silver. In 1910 there were treated in the mills of the county 1,515,636 tons, which yielded to the amalgamating plates and cyanide treatment (and including a small quantity of bullion from small lots

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treated by hand mortars) $5,229,963 in gold and 101,881 fine ounces of silver, with a total value of $5,284,979, at an average value per ton in gold of $3.45, and in gold and silver of $3.49. To smelters outside the State were sent 7,349 tons, containing $148,572 in gold and 16,585 fine ounces of silver, with a total value of $157,528, at an average of $20.22 in gold, and $21.44 in gold and silver.

The output of placer gold from 4 placers increased threefold. The Bear Gulch and the Potato Creek placers, near Tinton, Rawlins district, produced the bulk of the placer output. Small placers near Whitewood produced the remainder.

The Homestake Co., after closing November 23, 1909, to avoid a strike, started mines and mills again in January on a nonunion basis, but the mills were not running at full capacity until March 3, 1910. The latest public report[1] of the Homestake Co. for the fiscal year ending June 1, 1910 (which includes the period of inoperation), states that "the company mined 1,237,381 tons of ore of an average value of $3.6357 per ton, giving a bullion production of $4,498,751. There was a dividend disbursement of $982,800." The mills consist of 6 wet-crushing stamp mills, aggregating 1,000 stamps, capacity 4.2 tons per stamp per day. These stamp mills are known as the Amicus, Golden Star, Homestake, Mineral Point, Munroe, and Pocahontas. The company also operates two cyanide sand plants, with a capacity of 75,000 tons monthly, and one cyanide slime plant, with a capacity of 50,000 tons monthly. A saving will be made on bullion express charges, as the company sold its bullion after July, 1910, to the Deadwood assay office, Deadwood, instead of sending it to the New York assay office, as formerly. The company continued work throughout the year on its hydraulic electric plant in Spearfish Canyon, completed the preliminary construction work, and let the contract for the equipment of the power house. Approximately three-fourths of the distance, or 23,862 feet, the water is to be carried through a series of tunnels with cross section of 7 by 9 feet. It is expected that the plant will be running by July, 1911. The water will be delivered to three 3,000-horsepower overhung Pelton water wheels.

In the Bald Mountain area, except during the time of suspension due to the labor troubles, the mines were operated steadily. The Mogul Co., though idle a large part of the spring, kept its 350-ton mill at Pluma running continuously the rest of the year. The Golden Reward Co. started work March 21 and kept its Deadwood 200-ton wet-crushing cyanide mill in operation continuously from that date. The mine is opened by 6 vertical shafts, the deepest of which is 587 feet. A new sulphide ore body was opened on the Golden Reward property, and it is proposed to build a roaster at the mine and to increase the capacity of the mill at Deadwood. Crude ore from this property was shipped also to smelters outside the State. The Lundberg, Dorr & Wilson mill at Terry, a 100-ton cyanide plant, with a 6-foot Chile mill, was operated after June 18 on ores from the company's Buxton and Bonanza properties, and also on those from the Portland, and from Bertschy's lease on the McGovern mine of the Imperial property, the last two being the only producers in the Portland district. Crude ore to Denver smelters was also shipped from the Portland mine. The Portland Co. purchased the American

[1] Homestake Annual Report for year ending June 1, 1910: Mining World, Oct. 1, 1910, p. 608.

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Eagle mill during the year. Early in 1911 the Portland, Dividend, and American Eagle companies were combined as the Trojan Co. The New Reliance Gold Mining Co. at Stewart was idle in 1910.

In the Bear Butte (or Galena) district the Gilt Edge Consolidated Mining Co. ran its 200-ton cyaniding plant for some time, but, having proved the cyanide process unsuccessful, the company concluded at the end of the year to put in a concentrating plant for the treatment of the pyritic ore of the lower levels. The shaft on this property is 90 feet deep. Crude ore was shipped to smelters from the Richmond (or Sitting Bull) group. In 1909 the Branch Mint Operating Co. worked the Richmond dumps in the 120-ton Branch Mint mill. There were a few tons shipped from the Bristol or Ulrich property. At the close of the year preparations were made toward building a smelter at Galena, and since the end of 1910 the site has been chosen, the Chicago, Burlington & Quincy Railroad has built a spur to the smelter site, and the old Deadwood smelter has been purchased from the Golden Reward Co., such parts as can be used to be removed to Galena. The process has been worked out by Paul Danckwardt, backed by H. C. Osterman. The building of the smelter also embraces the plan of the Gilt Edge Co. to build a concentrating plant. The process includes the recovery of sulphur which might be obtained from the pyritous ores of the Galena and Two-Bit districts. These districts have been described by Irving.[1]

In the Carbonate district ore was shipped from the Iron Hill mine of the New Iron Hill Mining Co. This mine has been idle for 20 years. The production from the Iron Hill mine from 1885 to 1891, inclusive, was valued at $667,218.[2] The Black Hills Financial & Development Co. in 1910 was prospecting and opening up the Seabury-Calkins, the Home Run, and the Far West, as well as the Iron Hill mine in the Carbonate district, and also the Hammer group in the Galena district, and several properties in the Rochford district. The Iron Hill mine was unwatered and supplied lead ore to Denver smelters.

In the Maitland district the Minnesota Mines Co. was the only operator. This company operated the mine from January 1 to June 10 and the 150-ton cyanide mill for a period of 6 weeks at half capacity. The North Homestake Mining Co. was idle in 1910.

The Golden Crest Mining Co., in the Two-Bit district, near Galena, enlarged the shaft from 2 to 3 compartments, sunk the shaft from 200 feet to 340 feet, and drove 400 feet of drifts, and also built a 40-stamp, 200-ton wet-crushing cyanide mill, all sliming process with Moore filters. A small tonnage was shipped to Denver from the Monarch mine.

The 200-ton cyanide plant of the Wasp No. 2 Mining Co., in the Yellow Creek area, was destroyed by fire on January 25, 1910, but a new mill of 400 tons capacity was completed and in operation on December 1. The new mill is a dry-crushing plant and is built on the westerly slope of Whitewood Gulch. The ore, which is mined from open cuts, assays $2.20 to $3.60 per ton, with an average of $2.50, and mining and milling costs are $1.016, according to Simmons.[3]

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[1] Irving, J. D., Prof. Paper U. S. Geol. Survey No. 26, 1904, pp. 162, 169.
[2] Irving, loc. cit., p. 177.
[3] Simmons, Jesse, Wasp No. 2 cyanide mill: Eng. and Min. Jour., July 29, 1911, p. 214.

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Near Deadwood, in the Mowee mine, it is said samplings show the ore to carry zinc in quantity suitable for concentration and magnetic separation. Tests are being made to determine whether the ore can be successfully treated.

PENNINGTON COUNTY.

Only 3 deep mines in Pennington County made an output in 1910, as compared with 9 in 1909. The placer output was almost three times that of 1909. The total value of the county output in gold and silver was $21,508, of which $1,425 was from placers. There was no copper output in 1910.

At Mystic the Hymalulu Co. did considerable development and completed a 20-ton amalgamating and concentrating plant. A 10-stamp mill was being built on the Inca property. Several men were employed in prospecting and developing the property of the Mariposa Co. The Castle Creek Hydraulic Gold Mining Co. was building the first dredge in the Black Hills near Mystic, on Castle Creek, during 1910. A steam plant was also built to generate electricity to operate the dredge, the bucket line of which is to consist of 78 buckets of 5 cubic feet capacity each. At Deerfield the Prince placer was prospected, with the view of placing a dredge on the property.

At Hill City some development work was done on the Antlers mine. The Continental Copper Mining & Smelting Co. closed in November, 1909, because of labor troubles, and did not operate its 150-ton smelter during 1910, though some work was done in development of the mine, the shaft being sunk to 823 feet. No work was done on the Golden Slipper group. The Gertie Mining & Milling Co., owning a tin and mica property, the ore of which also carries gold, was occupied in 1910 in building a steam-power plant and concentration mill, which is to have a capacity of 100 to 125 tons per day, with a reverberatory smelter to smelt tin concentrates. No output was made by the Gold Medal Co. in 1910. Prospecting of the Maggie and Bessie placers, on Spring Creek, was done before testing with drills with a view of installing a hydraulic plant.

In the Hornblende district, near Rochford, development work was done on the Crown, Golden West, Gordelia, Lakota, North Star, Ray (in Lawrence County), and Teddy Bear mines.

At Keystone some ore from the Columbia mine was treated in a custom amalgamating and concentrating plant, and some ore was also shipped to Denver smelters. Development work was performed on the Bullion, Seminole, Lisbon, and North Fork mines, and on the properties of the Otho Development & Power Co.

At Oreville lessees on the Clara Belle mine, of the Forest City Co., milled the ore in the 10-stamp amalgamation mill on the property.

At Pactola producing placers were the McCurdy placer and that of the Pactola Hydraulic Placer Mining Co. The Rockerville Gulch placer, at Rockerville, was also a producer. Banks and other bullion buyers bought considerable placer gold from various sources in Pennington County. Deep mines at Pactola, on which development work was done, were the Harvest and the Tamarack.

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TEXAS.

By CHARLES W. HENDERSON.

PRODUCTION.

The following table shows the production of gold, silver, copper, and lead in Texas in 1909 and 1910:

Production of gold, silver, copper, and lead in Texas in 1909 and 1910.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1909	15.19	$314	374,444	$194,711	3,862	$502	91,140	$3,919	$199,446
1910	20.46	423	380,322	205,374	3,157	401	65,068	2,863	209,061
Increase (+) or decrease (−)	+5.27	+109	+5,878	+10,663	−705	−101	−26,072	−1,056	+9,615

According to the returns from 6 deep mines and from several small "clean-ups," the total value of mine production of gold, silver, copper, and lead in Texas for the calendar year 1910 was $209,061, an increase of $9,615. Silver constituted over 98 per cent of the value, the production being 380,322 fine ounces, valued at $205,374, as compared with 374,444 fine ounces in quantity and $194,711 in value for 1909. The output of copper, all from the Sierra Blanca district, El Paso County (and a small quantity from "clean-ups"), was 3,157 pounds, as compared with 3,862 pounds in 1909. The lead production, chiefly from Presidio County, with a small quantity from El Paso County and also a small quantity from "clean-ups," was 65,068 pounds, valued at $2,863, a decrease of 26,072 pounds in quantity and of $1,056 in value. There was no output of zinc in 1910.

Of the 6 mines from which there was an output in 1910, there were 4 in the Sierra Blanca district, El Paso County, and 2 in the Shafter district, Presidio County.

The total tonnage from mines sold or treated was 21,917 short tons, of which 17 tons was copper ore, 28 tons lead ore, and the remainder siliceous or dry ore, carrying some lead.

The average recovered content of the mine ore per ton in silver from dry ores (including contents recovered from tailings treated) was 17.35 ounces, valued in 1910 at $9.37, as compared with 17.23 ounces, or $8.96, in 1909. The average assay of ore shipped to the smelter was 0.172 ounce gold and 18.53 ounces silver per ton. The copper ore assayed 5.12 per cent in copper and lead ore averaged 39.13 per cent in lead and 20.39 ounces in silver per ton.

EL PASO COUNTY.

Small shipments of copper ore and dry ore, carrying lead, were made from the Sierra Blanca (or Lasca) district. The largest shipment was from the Beulah mine. Development work was done on

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the Lulu B. and McKinney, the Little Lightning, and the Sierra Blanca mines. There were several other prospects in this district, upon which some work was done.

There was some development work in the Allamoore district, at the southern foot of the Sierra Diablo range and some shipments were made early in 1911. Preparations were made to reopen the Hazel and the Black Shaft mines. The Hazel mine has been described by Richardson.[1]

JONES COUNTY.

A car of ore was shipped from the Pyron mine near Stamford, in Jones County, but was of no value because "unsuitable" for smelting. The ore is in the form of nodules of chalcocite, in the blue clays in the Permian.[2]

KNOX COUNTY.

Prospecting and development was done on the Harris & Harkins mine, in Permian beds, near Knox, and several cars of ore was taken out and stored. The operators plan to build a mill.

LLANO COUNTY.[3]

The Llano Gold & Rare Metal Mining Co. has been developing the Heath mine, near Llano, for several years, and the mine is now opened by 3 vertical shafts, 628 feet, 65 feet, and 90 feet, and 1 incline shaft 250 feet, the latter being sunk in 1910. In November, 1910, the company started the erection of a 40-ton mill, comprising a Chilian mill, amalgamating plates, and concentration equipment. Many traces of gold, silver, copper, and other minerals are found in the Llano district, and at various times in the past 50 years mining operations have been carried on upon the different claims.[4]

The Los Almagres and Roberta mines, in this district, are opened by vertical shafts 74 feet and 120 feet deep, respectively, and by drifts from each shaft.

PRESIDIO COUNTY.

Candelaria district.—It is reported that lead ore was taken out in this district, but none was shipped in 1910.

Shafter district.[5]—This district produced the greater part of the silver and lead output of the State, chiefly from the Presidio mine, which has been operating almost continuously since 1884. The mine is opened by several shafts, the two principal ones being over 500 and 700 feet deep, and by over 30 miles of underground workings, nearly all of which are above the 250-foot level. The ore bodies are for the

[1] Richardson, G. B., Reconnaissance of trans-Pecos Texas: Bull. Univ. Texas Mineral Survey No. 9, 1904, pp. 24–25.

[2] Cummins, W. F., Notes on the geology of northwest Texas: Fourth Ann. Rept. Geol. Survey Texas, 1893, pp. 232–238.

[3] Paige, Sidney, Mineral resources of Llano-Burnet region, Texas: Bull. U. S. Geol. Survey No. 450, 1911. Comstock, T. B., Report on the geology and mineral resources of the central region of Texas: Second Ann. Rept. Geol. Survey Texas, 1891, pp. 577–582. Also a preliminary report on the geology of the central mineral region of Texas: First Ann. Rept. Geol. Survey Texas, 1890, pp. 334–339.

[4] Hornaday, W. D., Mining activities in western Texas: Mining World, Dec. 31, 1910, p. 1236.

[5] Phillips, William B., Shafter silver district, Presidio County, Texas: Eng. and Min. Jour., Dec. 31, 1910, p. 1303.

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most part confined to the Cibolo limestone of the Carboniferous.[1] The ore, which is chiefly silver chloride (horn silver) with which are associated more or less isolated patches of silver-bearing galena, is crushed by stamps, 15 in number, followed by pan amalgamation, with sulphate of copper, salt, and quicksilver. Until within the last few years no attempt was made to save the lead in the ore, but at present the tailings from the mill are leased by a private individual, who concentrates over Wilfley tables, shipping a silver-lead-zinc concentrate to the El Paso smelter. The zinc is penalized at the smelter. The ore, however, is almost entirely free from zinc, but 2 miles to the west are large deposits of zinc ore ("dry bone").

Some zinc ore was mined from a zinc prospect in this district, but was not shipped.

Argentiferous galena ore was shipped to El Paso from the Last Chance mine, which has been opened by a vertical shaft 65 feet deep and a tunnel 185 feet long. The Silver Hill Mill & Mining Co., organized in 1910, owns 640 acres of land on which is a mine, operated 10 years ago by the Cibolo Mining Co.

UTAH.

By V. C. Heikes.

PRODUCTION.

Mine operators of 183 properties in Utah, 8 of which were placers, produced in 1910 gold, silver, copper, lead, and zinc, valued at $32,199,185. Compared with the 1909 figures, 4 more producing mines were reported and the total value increased $819,093. The metal mining industry of Utah in 1910 was characterized by an increase in the production of copper and zinc. The gigantic mining operations carried on at Bingham helped to advance copper from an output of 108,947,811 pounds in 1909 to 127,597,072 pounds in 1910, and in total value from $14,163,215 to $16,204,828. Silver production was second in value in 1910, taking the place of lead in 1909. The doubling of milling facilities for concentrating the low-grade copper ores occurring largely at Bingham was the cause of the increase of ore treated at concentration mills, from 3,771,960 tons in 1909 to 5,182,057 tons in 1910. The ore treated in 1910 yielded 300,880 tons of concentrate, containing about 25 per cent of the total yield of gold, 21 per cent of the silver, 73 per cent of the copper, 39 per cent of the lead, and 79 per cent of the zinc, and was valued at $16,842,290, or an average value of $55.98 per ton. The quantity of crude ores shipped directly to smelters in 1910 exceeded the tonnage of concentrate and aggregated 896,834 tons, valued at $14,544,678, at an average value of $16.22 per ton. This crude smelting ore contained about 56 per cent of the total yield of gold, 79 per cent of the silver, 26 per cent of the copper, 61 per cent of the lead, and 21 per cent of the zinc. In 1909 the smelting ores aggregated 1,003,575 tons, valued at $17,599,009, or an average value of $17.53 per ton. At milling plants using principally the cyanide process, there was produced from the treat-

[1] Udden, J. A., The geology of the Shafter silver mine district, Presidio County, Texas: Bull. Univ. Texas Mineral Survey No. 8, 1904, p. 54.

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ment of 263,041 tons of ore, gold and silver bullion valued at $756,617, an average recovery value of $2.88 per ton, as against the treatment in 1909 of 287,659 tons, valued at $826,688 and averaging a recovery of $2.87 per ton.

The variation in the metallic production of Utah during 1909 and 1910 is shown in the following table:

Mine production of gold, silver, copper, lead, and zinc in Utah, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	203,491.76	$4,206,548	195,052.11	$4,032,085	− 8,439.65	− $174,463
Silver.....do....	11,717,172	6,092,929	10,466,971	5,652,164	− 1,250,201	− 440,765
Copper.....pounds..	108,947,811	14,163,215	127,597,072	16,204,828	+ 18,649,261	+2,041,613
Lead.....do....	148,486,463	6,384,918	123,324,635	5,426,284	− 25,161,828	− 958,634
Zinc.....do....	9,860,778	532,482	16,367,104	883,824	+ 6,506,326	+ 351,342
Total.....	.....	31,380,092	.....	32,199,185	.....	+ 819,093

Total tons of ore sold or treated in Utah in 1904–1910, and total content of gold, silver, copper, lead, and zinc.

Year.	Tonnage.	Gold.[a]	Silver.[a]	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1904.....	1,716,947	202,675.00	12,049,446	46,417,234	116,479,764	73,439	$21,989,415
1905.....	2,181,061	248,692.00	11,036,471	57,298,054	103,882,009	3,330,327	25,824,387
1906.....	2,348,819	252,439.43	11,550,634	56,593,576	125,342,836	6,474,615	31,419,365
1907.....	2,669,696	247,759.63	10,990,076	64,256,884	115,938,037	5,452,916	31,692,911
1908.....	3,658,957	179,054.60	8,451,338	86,843,812	88,777,498	1,460,554	23,441,280
1909.....	5,122,589	203,491.76	11,717,172	108,947,811	148,486,463	9,860,778	31,380,092
1910.....	6,389,398	195,052.11	10,466,971	127,597,072	123,324,635	16,367,104	32,199,185

[a] Includes a very small placer production.

ORE PRODUCTION IN 1910.

Ore sold or treated in 1910 aggregated 6,389,398 tons, including small quantities of old slag sortings and smelter cleanings and old tailings re-treated. Compared with the production of 1909, the total production of ore mined or treated increased 1,266,809 tons in quantity, but in value per ton decreased from $6.12 in 1909 to $5.04 in 1910, caused principally by the largely increased production of low-grade porphyry ore. The average gold and silver value in the ore also decreased, from $2.01 to $1.51 per ton. There were increases in production of all kinds of ore, with the exception of lead ore. Dry or siliceous ore increased in quantity from 358,116 tons in 1909 to 391,568 tons in 1910, chiefly in Juab and Boxelder counties, where an increased tonnage of oxidized iron ore was mined, containing very small values in gold and silver. Copper ore production increased from 4,216,226 tons in 1909 to 5,417,558 tons in 1910. The increases were made in Salt Lake and Beaver counties, and decreases were largest in Juab and Boxelder counties. The production of lead ore decreased from 480,248 tons in 1909 to 329,058 tons in 1910. Juab County had the largest increase in output of lead ores, with Beaver County following; the largest decreases were in Salt Lake, Summit and Wasatch counties. Production of zinc ores increased from

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3,264 tons in 1909 to 4,954 tons in 1910. The output continues to come largely from one mine in Tooele County. Production of copper-lead ore increased from 4,460 tons in 1909 to 14,982 tons in 1910. The increase was largely due to the production in Salt Lake and Tooele counties, the yield being about the same as in 1909 in Beaver County. The output of lead-zinc ore increased from 60,275 tons in 1909 to 231,278 tons in 1910. Ore shipped from Bingham to the Midvale separating plant caused Salt Lake County to be a producer of lead-zinc ore, which helped to increase the total yield. The old tailings re-treated in the Park City region also helped to make the yield of this class of ore greater in 1910. The average value per ton of gold and silver in siliceous ore in 1910 was $3.25, as against $3.41 in 1909; and in lead ore, $12.32, against $10.55 in 1909. In zinc ore, there was a small average content of gold and silver in the Salt Lake and Beaver County output. The zinc ore of Tooele County contained no values in gold and silver. In copper-lead ore, the gold and silver recovery was $8.25, as against $12.13 in 1909; and in lead-zinc ore $3.33, as against $3.86 in 1909.

Subdivision of tonnage, by kinds, of ore sold or treated from Utah in 1910, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	2,107	65,534	13,019	859	2,229	.....	83,748
Boxelder and Morgan	17,837	6,282	173	.....	.....	.....	24,292
Iron and Piute	6,614	112	.....	.....	.....	.....	6,726
Juab	66,205	87,030	89,700	.....	42	.....	242,977
Salt Lake	8,268	5,258,600	76,804	78	11,316	87,192	5,442,258
Summit and Wasatch	2,713	.....	70,609	.....	.....	142,017	215,339
Tooele	287,824	.....	19,177	4,017	1,395	2,069	314,482
Utah	.....	.....	59,576	.....	.....	.....	59,576
Total	391,568	5,417,558	329,068	4,954	14,982	231,278	6,389,398
Value per ton in gold and silver	$3.25	$0.64	$12.32	$0.78	$8.25	$3.33	$1.51

GOLD.

The gold output decreased from 203,491.76 ounces, valued at $4,206,548, in 1909, to 195,052.11 ounces, valued at $4,032,085, in 1910. The largest decreases were made in Juab, Tooele, and Utah counties. The increase made in Salt Lake County almost offset the decrease made in Juab County. The cyanide process is used at the Mercur mines in Camp Floyd district of Tooele County, at the Jennie mine, in Iron County, and at the Sevier Consolidated property, in Piute County. A new plant was erected at Bingham, in Salt Lake County, and a small output of gold bullion resulted from the first operations the latter part of 1910. The Park Valley district, in Boxelder County, had the only amalgamation plant in operation during 1910. These plants treated 263,041 tons of ore, yielding $754,127 in gold, with an average gold recovery of $2.87 per ton. Concentrates of three kinds—copper, lead, and zinc—were produced at the concentration mills. Copper concentrates in largest quantities were pro-

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duced at the Garfield and Lark milling plants in Salt Lake County. The gold value of 300,880 tons was $988,860, or about one-fourth of the total gold production, and the average value per ton was $3.29. There were shipped to the smelters 896,834 tons of crude ore, containing $2,276,935 in gold, or about half of the total gold production, and the average value per ton was $2.54, as against an average value of $2.74 per ton in 1909. The gold yield from placer mining increased from $2,525 in 1909 to $3,980 in 1910. Placer gold was produced in Grand, San Juan, Uinta, and Wayne counties in 1910.

Source of gold production of Utah, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	.....	177.63	367.34	247.86	12.77	22.29	.....	827.89
Boxelder and Morgan	.....	919.13	.....	2.51	.....	.....	.....	921.64
Grand, San Juan, Uinta, and Wayne	192.53	.....	.....	.....	.....	.....	.....	192.53
Iron and Piute	.....	1,242.51	91.14	.....	.....	.....	.....	1,333.65
Juab	.....	8,020.41	34,833.89	14,291.72	.....	2.56	.....	57,148.58
Salt Lake	.....	1,262.39	78,686.12	2,187.61	4.95	104.41	3,671.33	85,916.81
Summit and Wasatch	.....	952.56	.....	2,021.94	.....	.....	1,492.98	4,467.48
Tooele	.....	34,642.22	.....	228.25	.....	25.37	.....	34,895.84
Utah	.....	.....	.....	9,347.69	.....	.....	.....	9,347.69
Total	192.53	47,216.85	113,978.49	28,327.58	17.72	154.63	5,164.31	196,052.11

SILVER.

The silver output of Utah decreased from 11,717,172 ounces, valued at $6,092,929, in 1909, to 10,466,971 ounces, valued at $5,652,164, in 1910. This indicated a decrease of 1,250,201 ounces in quantity and of $440,765 in value. The yield of silver in 1910 came principally from lead-ore mines in Juab, Summit, Wasatch, and Utah counties. Ore treated at concentration mills produced concentrate, which yielded about one-fifth of the total silver, or 2,161,967 ounces, averaging 7.18 ounces per ton. In 1909 the concentrates yielded 1,748,861 ounces and averaged 6.66 ounces per ton. Crude ore shipped directly to smelters contained about eight-tenths of the total silver, or 8,289,042 ounces, averaging 9.24 ounces per ton. In 1909 smelting ores yielded 9,956,271 ounces of silver, averaging 9.92 ounces per ton. Cyanide and amalgamation mills in 1910 yielded 4,612 ounces of silver, or an average of 0.02 ounce per ton, as against a yield of 5,153 ounces, averaging 0.018 ounce per ton, in 1909.

Source of silver production of Utah, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	.....	7,674	16,671	246,742	5,941	62,853	.....	339,881
Boxelder and Morgan	.....	202	.....	945	.....	.....	.....	1,147
Grand, San Juan, Uinta, and Wayne	25	.....	.....	.....	.....	.....	.....	25
Iron and Piute	.....	5,254	4,172	.....	.....	.....	.....	9,426
Juab	.....	370,026	829,994	2,634,361	.....	682	.....	3,835,063
Salt Lake	.....	92,230	1,186,072	361,104	569	126,893	239,263	2,006,131
Summit and Wasatch	.....	69,192	.....	1,513,444	.....	.....	989,135	2,571,771
Tooele	.....	3,920	.....	152,543	.....	32,680	.....	189,143
Utah	.....	.....	.....	1,514,384	.....	.....	.....	1,514,384
Total	25	548,498	2,036,909	6,423,523	6,510	223,108	1,228,398	10,466,971

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COPPER.

Nearly three-fourths of the copper produced was from the Bingham mines, whose low-grade porphyry ore was concentrated in the milling plants at Garfield. The sulphide copper ores shipped directly to the smelters yielded the next important quantity of copper. Utah's output of copper in 1910 amounted to 127,597,072 pounds, valued at $16,204,828, an increase of 18,649,261 pounds, which was fully credited to the Bingham or West Mountain district and helped to offset the large decreases in Boxelder, Tooele, Summit, and Beaver counties. An important increase was also made by the mines in the Tintic district of Juab County. Crude ore shipped to smelters in 1910 yielded over a fourth of the total copper, or 33,962,054 pounds, averaging 37.87 pounds per ton, equivalent to 1.89 per cent. Included in this crude ore to smelters was a small tonnage of sorted slag and smelter cleanings, containing 261,875 pounds of copper. Concentrates produced contained 93,368,026 pounds of copper, averaging 310.31 pounds per ton, equivalent to 15.51 per cent. The average copper content of copper-producing dry or siliceous ores classified as such in 1910 was 2.63 pounds per ton; of copper ores, 22.58 pounds per ton; of lead ores, 8.56 pounds per ton; of zinc ores, 0.33 pound per ton; of copper-lead ore, 38.59 pounds per ton; and of lead-zinc ores, 3.73 pounds per ton.

Source of copper production of Utah, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	19,097	898,420	114,304	1,005	95,959	.....	1,128,785
Boxelder and Morgan	102,887	1,039,762	312	.....	.....	.....	1,142,961
Iron and Piute	.....	12,127	.....	.....	.....	.....	12,127
Juab	716,003	7,096,460	1,200,063	.....	6,395	.....	9,018,921
Salt Lake	133,223	113,260,078	452,933	623	367,751	328,356	114,542,964
Summit and Wasatch	23,006	.....	866,793	.....	.....	533,830	1,423,629
Tooele	35,711	.....	171,425	.....	108,145	.....	315,281
Utah	.....	.....	12,404	.....	.....	.....	12,404
Total	1,029,927	122,306,847	2,818,234	1,628	578,250	862,186	127,597,072

LEAD.

The production of lead in 1910 amounted to 123,324,635 pounds, valued at $5,426,284, as against 148,486,463 pounds, valued at $6,384,918, in 1909. The greatest increase in lead production was in Tooele, Beaver, and Salt Lake counties. The largest decreases were made by the mines in Utah and Juab counties. A substantial increase was noted in Beaver County, made by the mines in the Star districts. The Park City region is credited with the largest output of lead, which aggregated 38,129,761 pounds; Tintic district, with 37,553,445 pounds; Bingham or West Mountain district, with 30,271,016 pounds; Ophir district, with 6,943,846 pounds; and Beaver County mines, with 6,235,535 pounds. Crude ore shipped to smelters contained 74,874,184 pounds, averaging 83.49 pounds per ton. Concentrates containing lead yielded 48,373,188 pounds, at an average of 160.77 pounds per ton. Lead contained in dry or siliceous ores averaged 1.33 pounds per ton; in copper ores, 0.04 pound per ton;

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in lead ores, 259.52 pounds per ton; in zinc ores, 44.67 pounds per ton; in copper-lead ores, 297.14 pounds per ton; and in lead-zinc ores, 140.56 pounds per ton. The copper ores containing lead were produced in Juab and Salt Lake counties, with a small quantity in Beaver County. This ore was treated at lead smelters. Small percentages of lead, contained in copper ores shipped to copper smelters, were eliminated from tabulation.

Source of lead production of Utah, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	21,985	38	4,391,876	206,246	1,615,888	.....	6,235,535
Boxelder and Morgan	.....	.....	39,263	.....	.....	.....	39,263
Juab	222,083	191,653	19,220,310	.....	13,559	.....	19,647,605
Salt Lake	242,146	30,436	17,980,717	15,046	984,665	12,154,825	31,407,835
Summit and Wasatch	34,469	.....	18,153,446	.....	.....	19,941,846	38,129,761
Tooele	1,363	.....	6,354,363	.....	1,838,180	413,800	8,607,706
Utah	.....	.....	19,256,930	.....	.....	.....	19,256,930
Total	522,046	222,127	85,396,907	221,292	4,451,792	32,510,471	123,324,635

ZINC.

The zinc production, from ore and concentrate, after smelting losses were accounted for, was 16,367,104 pounds, figured as spelter, valued at $883,824, as against a production in 1909 of 9,860,778 pounds, valued at $532,482. Mills of the Park City region continued to produce the largest quantities of zinc middlings and concentrate, which in 1910 yielded 9,437,992 pounds of spelter. Concentrates shipped from the Daly West mill were recovered from the ores by wet concentration, and at the Grasselli Chemical Co. mill from Daly-Judge and other middlings by dry concentration methods. The Scranton mine, in Tooele County, continued to produce important tonnages of zinc silicate, a large part of which, containing small quantities of lead, was sold on the eastern markets and utilized in the manufacture of pigment. Ore containing zinc was produced from the United States mines at Bingham and shipped to the company's concentration plant at Midvale, and there separated by electrostatic process into products of three kinds. The pyritic concentrate included some lead, a little copper, and gold and silver; the lead concentrate and the zinc concentrate contained the same metals. Some ores from outside sources were experimented upon, but no large tonnages have been received for treatment. Zinc contained in lead-zinc ores aggregated 13,798,922 pounds and in zinc ores 2,568,182 pounds.

MINING INDUSTRY IN UTAH IN 1910.

Each of the last three years has seen a marked increase in quantity of ore mined and of copper produced in Utah. The production of ore and copper from Bingham camp has steadily increased, due to extensive mining of large disseminated deposits in monzonite porphyry. This vast low-grade copper deposit at Bingham is now almost entirely controlled by the Utah Copper Co., which absorbed the Boston Consolidated interests early in 1911. Comparatively speaking, the only other important producer of low-grade porphyry ore is the Ohio Copper mine.

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The Tintic district in Juab and Utah counties and the Park City district in Summit and Wasatch counties furnished the greater part of the output of silver. Salt Lake County also added to the production of silver from copper and lead ores. The Iron Blossom mine in Tintic district developed siliceous ores carrying silver, but with the exception of a limited tonnage shipped to the smelters did not produce extensively from this class of deposit, pending arrangements for possible cyanide treatment. The Centennial-Eureka mines added appreciably to the output, as did also the Silver King, the Daly West, and other Park City mines.

Out of 9 smelting establishments in Utah, 3 were operated throughout the year—those at Garfield, Murray, and Midvale. The Yampa copper smelter, near Bingham, was closed on the last of August, the ores of the Yampa mine being diverted to the Garfield copper furnaces. In July the new International smelter, near Tooele, was first regularly operated and the first blister copper was poured August 27, and at the close of the year 3 reverberatories and 2 converters were smelting copper ore. The principal Utah ores treated at Tooele in 1910 were those from the Highland Boy mine, at Bingham, and concentrate and ore from the Cactus mine, at Newhouse. The American Smelting & Refining Co. so improved its Garfield copper-smelting plant that it can make a larger output of blister copper. It operated 5 reverberatories and was warming up the sixth, recently constructed, and 5 Pierce-Smith basic lined converters were in use, while 3 blast furnaces out of 4 were running. Its Murray lead plant had 4 furnaces in operation. The United States Co. was operating 6 furnaces on lead ore continuously throughout 1910. Its bag house continued to give perfect satisfaction and no damage was reported by the farmers.

Milling plants were constructed and remodeled at Bingham, Park City, Garfield, and at the Midvale concentrator of the United States Co. The work of the Huff electrostatic separators was good and 45 tons of zinc concentrate were produced per day. A second unit was added to the Ohio Copper mill, which brought its capacity up to 1,800 tons a day—an important gain. The Copperton mill of the Utah Copper Co. was dismantled after having been closed down in July. Most of the machinery was moved to Garfield and used in the Arthur plant (formerly the Boston Consolidated), which, soon after its acquisition by the Utah Copper Co., was equipped with Chili mills in place of Nissen stamps. With these changes the Arthur mill and the Magna plant are expected to concentrate about 20,000 tons of ore a day. These mills all have rolls and Chili mills, as it seems that when the copper ore is broken to 1½-inch size and crushed with rolls it is done at less cost than can be accomplished with stamps. Chili mills are said to be preferable for the finer grinding of copper ore, as they do not tend to slime the product, which is objectionable for concentration. The Cactus mill, in Beaver County, which was recently reconstructed, began handling in September, 1910, from 400 to 500 tons of ore, which quantity was gradually increased.

The capacity of the mill is 800 to 1,000 tons daily. A new venture at Bingham is the cyaniding of siliceous ores from one of the United States mines in a mill operated by the Utah Leasing Co., which was started in the latter part of 1910. At Park City the Little Bell mine was equipped with a 100-ton concentration mill, which began

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operating in November; and the mill of the Grasselli Chemical Co., using Sutton dry tables, dielectric separators, and dry sizing apparatus, treated a large tonnage of zinc middlings from the Daly Judge mill and from other sources; the zinc concentrates were shipped to the refinery of the company at Cleveland, Ohio. In December this company completed a new 125-ton wet concentration mill for treating a large tailing dump. The 1,550-foot level of the Daly West mine was driven to the Daly Judge lines for drainage purposes. The Daly West workings were also connected with the Ontario drainage tunnel. Operators of the Ontario, Daly, and Daly West mines will also push their drainage tunnel to the Thompson-Quincy property, a consolidation of the old Thompson and West Quincy mines.

Railroad building in 1910 was confined to the Bingham & Garfield Railroad, which is owned by the Utah Copper Co. interests, to operate between Bingham and Garfield, a distance by rail of 17 miles. This work is about 85 per cent complete, and it is expected that the 4 long tunnels will be ready for laying rails in April, 1911. Transportation of ore is expected to begin in August. The transportation facilities for handling the tonnage from Bingham to the mills at Garfield, while not sufficient at all times, were better than during the latter part of 1909 and the first months of 1910. In May and June a large tonnage was handled over the single line of the Denver & Rio Grande. On May 23, this road moved 217 cars for the Utah Copper Co. in 10 hours, and on May 24, 378 cars were loaded and sent out by the Utah Copper Co. and 24 cars by the United States Mining and the Utah Consolidated companies, making 402 cars in 24 hours, or approximately 22,000 tons of ore handled in one day.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1910, by counties.

County.	Ore sold or treated.	Gold.		Silver.	
		Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ozs.*		*Fine ozs.*	
Beaver	83,748	827.89	$17,114	339,881	$183,536
Boxelder and Morgan	24,292	921.64	19,052	1,147	619
Grand, San Juan, Uinta, and Wayne	.....	192.53	3,980	25	14
Iron and Piute	6,726	1,333.65	27,569	9,426	5,090
Juab	242,977	57,148.58	1,181,366	3,835,063	2,070,934
Salt Lake	5,442,258	85,916.81	1,776,058	2,006,131	1,083,311
Summit and Wasatch	215,339	4,467.48	92,351	2,571,771	1,388,756
Tooele	314,482	34,895.84	721,361	189,143	102,137
Utah	59,576	9,347.69	193,234	1,514,384	817,767
Total	6,389,398	195,052.11	4,032,085	10,466,971	5,652,164

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaver	1,128,785	$143,356	6,235,535	$274,363	513,733	$27,742	$646,111
Boxelder and Morgan	1,142,961	145,156	39,263	1,728	.....	.....	166,555
Grand, San Juan, Uinta, and Wayne	.....	.....	.....	.....	.....	.....	3,994
Iron and Piute	12,127	1,540	.....	.....	.....	.....	34,199
Juab	9,018,921	1,145,403	19,647,605	864,495	.....	.....	5,262,198
Salt Lake	114,542,964	14,546,950	31,407,835	1,381,945	3,572,347	192,907	18,981,177
Summit and Wasatch	1,423,629	180,801	38,129,761	1,677,709	9,437,992	509,651	3,849,268
Tooele	315,281	40,041	8,607,706	378,739	2,843,032	153,524	1,395,802
Utah	12,404	1,575	19,256,930	847,305	.....	.....	1,859,881
Total	127,597,072	16,204,828	123,324,635	5,426,284	16,367,104	883,824	32,199,185

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Tons of ore sold or treated, number of deep mines producing, and value of ores in Utah in 1909 and 1910, by counties.

County.	Ore sold or treated (short tons).		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	1910	Increase (+) or decrease (−).	1909	1910	1909	1910	1909	1910
Beaver	83,748	+ 25,881	20	21	$10.43	$7.71	$2.73	$2.39
Boxelder, Millard,[b] Morgan, and Washington[b]	24,292	− 6,981	7	4	19.45	6.85	.40	.81
Grand, San Juan, Uinta, and Wayne[c]		− 46	2		27.41		21.63	
Iron and Piute	6,726	+ 6,050	7	8	12.78	5.08	12.03	4.85
Juab	242,977	+ 59,598	35	38	27.18	21.66	17.95	13.38
Salt Lake	5,442,258	+1,261,629	44	52	3.86	3.49	.59	.52
Summit and Wasatch	215,339	+ 19,167	18	17	21.11	17.87	8.00	6.88
Tooele	314,482	− 79,243	24	22	3.78	4.44	2.45	2.62
Utah	59,576	− 19,246	17	13	43.20	31.22	23.27	16.97
Total	6,389,398	+1,266,809	174	175	6.12	5.04	2.01	1.52

[a] Value per ton, placer product excluded. [b] No production in 1910. [c] No production in 1909.

Tonnage of ore to gold and silver mills and concentrating mills, with gold and silver contained in bullion produced in Utah in 1910, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Beaver				65,628
Boxelder, Millard,[a] Morgan, and Washington[a]	3,122	919.13	202	
Iron and Piute	6,567	802.01	1,825	
Salt Lake	460	124.61	2,512	4,937,285
Summit and Wasatch				175,830
Tooele	252,892	34,635.15	73	234
Utah				3,080
Total	263,041	36,480.90	4,612	5,182,057

[a] No production in 1910.

Mine production of gold, silver, copper, lead, and zinc from Utah concentrates in 1910, by counties.

County.	Concentrates produced.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver	4,959	362.90	7,941	884,684	23,447		$125,177
Salt Lake	239,693	45,316.30	837,017	91,835,940	23,079,861	3,521,430	14,257,595
Summit and Wasatch	55,349	2,021.57	1,301,881	645,370	24,770,316	9,437,992	2,426,312
Tooele	109	3.00	1,369	2,032	48,935		3,213
Utah	770	132.35	13,759		450,629		29,993
Total	300,880	47,836.12	2,161,967	93,368,026	48,373,188	12,959,422	16,842,290

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Mine production of gold, silver, and associated metals from Utah crude ore shipped to smelters in 1910, by counties.

County.	Crude ore to smelter.						Total value.
	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver	17,933	461.85	330,485	243,426	6,184,289	513,733	$518,775
Boxelder, Millard,[a] Morgan, and Washington[a]	21,170	2.52	945	1,142,961	39,263	.....	147,447
Iron and Piute	159	531.64	7,601	12,127	.....	.....	16,633
Juab	242,977	57,148.58	3,835,063	9,018,921	19,647,605	.....	5,262,198
Salt Lake	501,644	40,084.49	1,157,205	22,445,824	8,294,062	50,917	4,671,817
Summit and Wasatch	30,140	2,445.90	1,269,890	778,259	13,359,445	.....	1,422,957
Tooele	26,315	256.45	187,228	308,132	8,543,219	2,843,032	674,962
Utah	56,496	9,215.34	1,500,625	12,404	18,806,301	.....	1,829,889
Total	896,834	110,146.77	8,289,042	33,962,054	74,874,184	3,407,682	14,544,678

[a] No production in 1910.

Number of producing mines classified by chief products in Utah, in 1910, by counties.

County.	Total.	Gold placer mines.	Deep mines.							
			Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, and lead.	Gold, silver, copper, lead, and zinc.	Gold, silver, and lead.	Silver and lead.	Silver, lead, and zinc.
Beaver	21	.....	.....	.....	4	10	[a] 3	3	.....	1
Boxelder, Millard,[b] Morgan, and Washington[b]	4	.....	.....	1	[c] 1	2	.....	.....	.....	.....
Grand, San Juan, Uinta, and Wayne[d]	8	[e] 8	.....	.....	.....	.....	.....	.....	.....	.....
Iron and Piute	8	.....	.....	4	4	.....	.....	.....	.....	.....
Juab	38	.....	.....	2	7	19	.....	8	[illegible]	.....
Salt Lake	52	.....	.....	.....	7	36	[f] 3	2	[illegible]	[g] 1
Summit and Wasatch	17	.....	.....	.....	.....	6	6	.....	.....	[g] 5
Tooele	22	.....	.....	[h] 4	.....	9	.....	[illegible]	.....	1
Utah	13	.....	.....	.....	.....	7	.....	5	1	.....
Total	183	3	.....	11	23	89	12	26	6	8

[a] Two silver, copper, lead.
[b] No production 1910.
[c] Copper only.
[d] No production in 1909.
[e] One dredge.
[f] One silver, copper, lead.
[g] Gold in addition.
[h] One reported gold only.

REVIEW BY COUNTIES.

BEAVER COUNTY.*

Mine production of gold, silver, copper, lead, and zinc in Beaver County, Utah, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	762.92	$15,771	827.89	$17,114	+ 64.97	+$1,343
Silver.....do....	273,977	142,468	339,881	183,536	+ 65,904	+41,068
Copper.....pounds..	1,247,235	162,141	1,128,785	143,356	−118,450	−18,785
Lead.....do....	5,766,356	247,953	6,235,535	274,363	+469,179	+26,410
Zinc.....do....	656,457	35,449	513,733	27,742	−142,724	− 7,707
Total.....	.....	603,782	.....	646,111	.....	+42,329

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Reports from 21 deep mines in 1910, against 20 in 1909, gave a yield of 83,748 tons of ore, which was 25,881 tons greater than in 1909. The total average value of this ore per ton decreased from $10.43 in 1909 to $7.71 in 1910, and the average value of the gold and silver content decreased from $2.73 to $2.39 per ton. Of the ore mined, 65,628 tons was milled, producing concentrate which contained gold, silver, copper, and lead, valued at $125,177, at an average value of $25.24 per ton. The larger part of the product was copper concentrate, produced from the Cactus mill in the San Francisco district. The crude shipping ores aggregated 17,933 tons, largely sulphides, and yielded at smelters gold, silver, copper, lead, and zinc, valued at $518,775, at an average value of $28.93 per ton. No ores were treated at amalgamation mills in 1910. Four mines in the county yielded siliceous and dry ores—more than half was oxidized iron ore containing lead and small values in silver and gold from the Cave mine in the Bradshaw district. The ore from the Hub-Lady Bryan and a small lot from the Warrior lease, in the Star district, brought the aggregate of this kind of ore to 2,107 tons, which contained 177.63 ounces of gold, 7,674 ounces of silver, 19,097 pounds of copper, and 21,985 pounds of lead. Copper ore, much of it sulphides from 6 mines, aggregated 65,534 tons, containing 367.34 ounces of gold, 16,671 ounces of silver, and 898,420 pounds of copper. The Cactus mine, in the San Francisco district, was the largest producer of this kind of ore. Thirteen properties produced 13,019 tons of lead ore—1 was in the Bradshaw district, 4 were in the San Francisco district, and 8 in the Star district. The metalic content was 247.86 ounces of gold, 246,742 ounces of silver, 114,304 pounds of copper, and 4,391,878 pounds of lead. Zinc ore was produced from 2 properties, a silicate ore from the Cedar-Talisman and a sulphide from the Horn Silver. The total yield of 859 tons was 12.77 ounces of gold, 5,941 ounces of silver, 1,005 pounds of copper, 206,246 pounds of lead, and 513,733 pounds of zinc. The copper and gold came from the Horn Silver ore. Ore from the Moscow mine, in the Star district, was classed as copper-lead ore, and contained silver and small gold values.

Bradshaw district.—Siliceous and dry ores were produced by 2 mines. The Cave property yielded an important tonnage of oxidized iron ore, containing a little lead and small values in silver and gold. One other claim, the Nip & Tuck, in the same region produced similar ores, and the Summit mine produced oxidized lead ore with silver, gold, and copper.

San Francisco district.—Late in November construction was begun on a testing mill for the Horn Silver mine at Frisco. Crusher rolls, Wilfley tables, and jigs were to be put in to handle daily from 75 to 100 tons of low-grade ore. Large quantities of zinc-lead ore of milling grade have been found on every level in the mine, but the quantity of shipping ore in sight is limited. According to the company report for 1910, the yield from 10,657 tons of ore at an average value of $8.96 per ton was 174.40 ounces of gold, 206,499 ounces of silver, 52,229 pounds of copper, 3,179,146 pounds of lead, and 337,776 pounds of zinc. At the Cactus mine and mill, at Newhouse, operations were resumed in September. The concentrate, largely chalcopyrite, assays about 18 per cent of copper and 30 per cent of iron, is high in silica, and is shipped to the smelter at Tooele.

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Star districts.—Production of lead ore in largest quantities was made from the Moscow mine, which has the credit of shipping the highest grade, and its neighbor, the Red Warrior, was almost as productive. These mines are developed to a depth of 500 feet. In the Lady Bryan and the Hub properties have been developed large bodies of iron, lead, and silver ore in a vertical vein and of copper ore in bedded veins, shipments of both kinds having been made. The Harrington-Hickory group, near Milford, is developed to a depth of 600 feet, the year's work resulting in exposing a large tonnage of silver-lead and copper ore. Other producers of shipping ore were the Cedar Talisman, Blue John, Wild Bill, St. Mary, Gold Crown, and White Rock properties.

BOXELDER COUNTY.

Lucin district.—Ore shipments from the Copper Mountain mine consisted largely of oxidized iron ore, valuable at the smelters as a flux, which carried small values in gold, silver, and copper. Copper ore of sorted grade was shipped by lessees.

Park Valley district.—The Susannah mine continued to be operated, and increased shipments of gold bullion were made from the operations of its 35-ton Chili mill.

GRAND COUNTY.

Placers in the vicinity of Dewey and Mesa, worked by sluicing, produced gold bullion valued at $801.

IRON COUNTY.

Good Springs district.—A small clean-up from the mill of the Jennie mine was made in 1910 from ore taken out in development work. The electric-power plant at Modena, which was constructed and equipped with producer gas equipment, was not successfully operated. This plant was to supply the power for the mines in this and adjoining districts in Nevada.

JUAB COUNTY.

Mines were operated in four districts in 1910, and the total output of the county aggregated 242,977 tons of ore, an increase of 59,598 tons over the output of 1909. There were 38 mine operators in 1910, against 35 in 1909, and the total value of the product, containing gold, silver, copper, and lead, was $5,262,198. The principal part of this output was from the Tintic district, which has the larger part of its mineral area in this county, the smaller part lying in Utah County. In 1910 the total value of the yield slightly increased over the total value of 1909, and the mines in Utah County produced less than half in value of the 1909 output.

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Tintic district.—The following table shows the production of Tintic district in 1909 and 1910:

Mine production of gold, silver, copper, and lead in the Tintic district, Juab and Utah Counties, Utah, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	83,189.47	$1,719,679	66,289.22	$1,370,320	− 16,900.25	− $349,359
Silver.....do....	6,404,847	3,330,520	5,222,742	2,820 281	− 1,182,105	− 510,239
Copper.....pounds..	5,915,669	769,037	8,993,036	1,142,115	+ 3,077,367	+ 373,078
Lead.....do....	56,502,209	2,429,595	37,553,445	1,652,352	−18,948,764	− 777,243
Total.....	.....	8,248,831	.....	6,985,068	.....	−1,263,763

Division of Tintic district metallic output in 1910, by counties.

County.	Number of mines.	Quantity of ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Juab.....	33	242,129	57,124.63	3,743,800	8,992,859	18,906,002	$5,176,480
Utah.....	7	58,502	9,164.59	1,478,972	177	18,647,443	1,806,588

On the Juab County side of this district 33 mines produced in 1910 and 7 were in Utah County; they yielded a combined output aggregating 300,631 tons of ore, valued at $6,985,068, at an average value of $23.23 per ton, as against the production made in 1909 of 260,104 tons, valued at $8,248,831, with an average value of $31.71 per ton. Almost all of this production was ore of shipping grade, the exception being 3,080 tons of ore treated at a concentration plant, which yielded lead concentrate, principally carbonates, containing gold and silver valued at $29,993, with an average value of $38.95 per ton. Dry or siliceous ores carrying small quantities of copper and lead, produced by 6 mines situated in Juab County, aggregated 66,205 tons and contained 8,020.41 ounces of gold, 370,026 ounces of silver, 716,003 pounds of copper, and 222,083 pounds of lead. The Dragon mine produced an oxidized iron ore, which forms the larger part of this tonnage and contains a very small quantity of gold and silver per ton. The strictly siliceous ores were produced by the Grand Central, Mammoth, and Victoria properties, ore from each containing copper and lead, with the gold and silver values. Copper ores were mined entirely from 10 Juab County properties, which produced 86,941 tons, containing 34,827.73 ounces of gold, 829,706 ounces of silver, and 7,070,398 pounds of copper. The largest producers of copper ore were the Centennial Eureka, Golden Chain, Opohongo, Mammoth, Lower Mammoth, and Carisa properties, in order of production. The Governor claim and the Black Jack mine were also small producers of copper ore. Lead ores were produced in the district from both sides of the county line, 22 mines in Juab County yielding the largest quantity of ore, which aggregated 88,941 tons, containing 14,273.93 ounces of gold, 2,543,386 ounces of silver, 1,200,063 pounds of copper, and 18,673,707 pounds of lead. The greatest quantity of

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lead ore and the largest percentage of lead are credited to the Iron Blossom mine; the Uncle Sam mine was the second largest producer of lead, followed by the Gemini, Eagle & Blue Bell, Centennial Eureka, and Ridge & Valley mines. Six mines in Utah County yielded 58,502 tons of lead ore, containing 9,164.59 ounces of gold, 1,478,942 ounces of silver, 177 pounds of copper, and 18,647,443 pounds of lead. The Colorado mine was the largest producer of lead in Utah County, followed by the Sioux, the May Day, and the Yankee mines. Other producers were the Beck Tunnel, Salvator, and East Tintic Development mines. No zinc ores were produced. The different kinds of ore produced in the district in 1910 yielded as follows:

Mine production of Tintic district, Juab and Utah Counties, in 1910, by kinds of ore and metal output of each.

Kind of ore.	Quantity of ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Siliceous	66,205	8,020.41	370,026	716,003	22,083
Copper	86,941	34,827.73	829,706	7,070,398	196,653
Lead	147,443	23,438.52	4,022,328	1,200,240	37,321,150
Copper-lead	42	2.56	682	6,395	13,559
Total	300,631	66,289.22	5,222,742	8,993,036	37,553,445

During 1910 the Centennial-Eureka mine [1] produced ore amounting to 90,419 tons, against 109,430 tons in 1909. Development added as much to the tonnage as was taken out. The ore production was affected by the introduction of the pumping plant, which was begun in 1909 and completed in 1910. The water is being raised to the Holden tunnel, which connects with the shaft at a depth of 550 feet. This tunnel is used both for drainage and as the main haulage way, being operated by an electric tramway. This mine is developed to a depth of 2,300 feet and the Holden tunnel is 2,207 feet long.

The Chief Consolidated mine [2] yielded 6,947 tons of ore, containing 440 ounces of gold, 433,850 ounces of silver, 525,552 pounds of lead, the total of which, after payment of smelter charges and transportation, netted $177,639.12 and a net average of $25.57 per ton. The underground work was mainly performed on the 1,400-foot level, where ore in quantity was first discovered. The development of the levels above and below is being directed from this known ore.

The Eagle and Blue Bell mine [1] produced 5,769 tons of silver-lead and siliceous ore valued, for its gold, silver, and lead, at $122,958. It is opened by 2 shafts, one sunk 1,000 feet at the end of a 1,200-foot tunnel, and the other the continuation of an old shaft which was completed from 220 feet to 1,000 feet in depth in 1910. A large tonnage of oxidized iron ore, with very small quantities of gold and silver, was shipped from the Dragon mine. The Eureka Hill mine was operated, lessees shipping a highly siliceous ore containing silver and small quantities of gold and copper. At the Gemini prospecting on various levels resulted in finding a good shipping grade of lead-

[1] Ann. Rept. for calendar year 1910, published by the U. S. Smelting, Refining & Mining Co.
[2] Ann. Rept. Chief Consolidated Mining Co. for calendar year 1910.
[3] Ann. Rept. Bingham Mines Co. for calendar year 1910.

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silver sulphide ore, carrying a little copper. The Golden Chain mine was worked from the 1,000-foot Ajax shaft, which now belongs to that property. Copper ore containing good gold and small silver values was produced. The Grand Central mine produced ore from all levels to 2,100 feet, the shipments containing gold, silver, copper, and lead. At the Mammoth an accident to the shaft delayed ore production. Considerable silver-lead and copper ore was produced from the Lower Mammoth mine. The Uncle Sam, May Day, and Yankee properties in the north end of the district were active, and the Colorado, Iron Blossom, and Sioux properties each yielded a large tonnage of ore. The Iron Blossom yielded heavily from its 400-foot and 500-foot levels, and recently ore has been found on the 800-foot level. For the fiscal year ending November 30 this mine produced from its No. 1 shaft 15,074 tons of siliceous ore, containing 3,990.78 ounces of gold, 414,724 ounces of silver, 138,637 pounds of lead, and 21,669 pounds of copper, valued in all at $292,705, or an average of $19.42 per ton. The largest ore bodies of the mine are developed through the No. 1 shaft, and a large part of the output was mined in development. This is the deepest shaft on the east side of the district. At a depth of 1,900 feet a flow of water was encountered and further sinking abandoned. No. 3 shaft is near the Sioux mine and through it all of the lead ore was hoisted, aggregating 20,858 tons, which contained 3,996.95 ounces of gold, 726,624 ounces of silver, and 6,506,414 pounds of lead, valued in all at $616,871, or an average value of $29.57 per ton. The smelting charges on the siliceous ores from the Iron Blossom mine have been considered high and tests are being made with a view to treatment by the cyanide process. At the Colorado mine, for the fiscal year ending November 1, the ore output was 25,654 tons, containing 4,842.66 ounces of gold, 919,841 ounces of silver, and 10,177,904 pounds of lead. Development has been done from two working shafts, the deepest of which is 500 feet. The Beck Tunnel mine yielded an oxidized lead ore from comparatively shallow depths. Its main shaft is 1,100 feet deep. At the Sioux mine no new discoveries were made; the shipments consisted of oxidized lead ore, containing gold and silver, taken from a depth of 450 feet.

Fish Springs district.—Lead ore from the Utah mine was shipped regularly during 1910, but in less quantities than usual, pending the development of new territory.

MORGAN COUNTY.

Shipments of lead-silver ore were made from the Carbonate Hill mine, situated near Peterson.

PIUTE COUNTY.

Some rich gold ore from the Bully Boy and Webster properties, near Marysvale, was taken out by trenching on a vein at the surface. The Sevier mine and mill, in the Gold Mountain district, were operated by a company testing the property, which was closed in November, and some gold and silver bullion from cyanide treatment of the ores was shipped. The Shamrock, Glen Erie, and Monroe groups in the Ohio district produced copper ore. At the Deer Trail a force

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has been steadily at work developing, and there is a very large tonnage of low-grade gold ore of cyanide grade reported blocked out. Tests on it show that in treatment it slimes badly, but that this will not prevent a profitable extraction.

SALT LAKE COUNTY.

The total yield of ore from 52 mines in the county aggregated 5,442,258 tons in 1910, which is 1,261,629 tons greater than in 1909, when 44 mines produced. The total average value per ton in the ore for the gold, silver, copper, lead, and zinc contained decreased from $3.86 in 1909 to $3.49 in 1910, and the gold and silver value of this ore from 59 cents to 52 cents per ton. The mine production from this county is chiefly that of the Bingham or West Mountain district, yielding concentrating and crude smelting ores and a small tonnage of siliceous ore, which was treated in a cyanide plant, the first to be operated since the trials made about 15 years ago.

Big and Little Cottonwood districts.—The table following gives the production of the mines in the Big and Little Cottonwood districts combined for six years:

Number of mines producing in Big and Little Cottonwood districts, and total tons of ore sold or treated in 1905–1910, and total content of gold, silver, and associated metals.

Year.	Number of mines producing.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
1905	6	26,003	950.00	371,683	811,639	1,702,258	$450,756
1906	10	20,801	762.07	345,102	1,193,743	1,922,276	586,933
1907	11	19,896	976.93	399,417	1,074,238	2,337,924	622,568
1908	21	5,866	321.35	63,246	269,212	603,840	101,061
1909	15	13,208	335.72	158,867	1,842,711	332,475	343,400
1910	17	14,203	381.87	202,010	804,018	1,102,907	267,617

As noted in the table, there is an increase from 15 mines in 1909 to 17 in 1910 and an increased tonnage of ore containing comparatively the same quantities of gold and silver, a decreased quantity of copper, and a very large increase in output of lead. The 1910 output of ore was classified chiefly as copper-lead ore, which aggregated 11,233 tons, containing 98.31 ounces of gold, 123,578 ounces of silver, 354,501 pounds of copper, and 957,503 pounds of lead. The output of copper ore, the next largest in quantity, aggregated 2,463 tons, containing 177.22 ounces of gold, 61,054 ounces of silver, 445,892 pounds of copper, and 3,973 pounds of lead. This lead was contained in copper ore shipped to a lead smelter. The largest producer of lead ore was the Columbus Consolidated mine, the Cardiff mine yielding the next largest quantity, followed by the Columbus Extension, Jefferson, and South Columbus properties. Lead ore aggregated 447 tons from 9 properties and contained 15.19 ounces of gold, 17,356 ounces of silver, 3,625 pounds of copper, and 141,431 pounds of lead. The principal producer of lead ore was the Baby McKee mine, the Black Bess yielding the next most important quantity of rich lead ore. Sixty

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tons of siliceous ore were produced from the Jefferson mine, and contained only gold and silver. Two-thirds of the ore in 1910 was concentrated and yielded 2,152 tons of concentrate, 35.24 ounces of gold, 62,154 ounces of silver, 154,924 pounds of copper, and 570,955 pounds of lead, with a total value of $79,088, or an average value of $36.75 per ton. The remainder of the output of the districts was crude ore shipped to smelters and aggregated 4,871 tons, which contained 255.47 ounces of gold, 139,834 ounces of silver, 649,094 pounds of copper, and 531,952 pounds of lead, valued at $186,632, or an average value of $38.31 per ton. A small tonnage was treated at a milling plant equipped for amalgamation, producing gold and silver bullion.

Alta is still handicapped for lack of proper transportation facilities. The South Columbus and the Alta-Hecla groups are under the control of operators of the South Hecla. In these holdings are found over 5½ miles of workings, consisting of tunnels, drifts, raises, and winzes. During 1910 the company shipped a little over $5,000 worth of ore, net smelter returns. The ore averaged about 6 per cent of copper, and 10 per cent of lead, and 20 ounces of silver per ton.

Operators of the Columbus Extension cut ore early in the fall of 1910 by the 4,000-foot tunnel, and about 1,000 tons of this ore have been sent to the smelters.

The Columbus mine produced in 1910 in the neighborhood of 5,000 tons of ore. The company has been greatly retarded in development work, its lower levels being flooded with water.

In the Big Cottonwood district the development of the Black Bess and other holdings of the Utah Mines Coalition has been successful. The main tunnel has been driven a distance of 3,100 feet, and at a point about 2,750 feet from the portal encountered an ore vein, which is now being developed and from which shipments are being made.

West Mountain or Bingham district.—This district has the record of the largest tonnage of ore mined in the State, the output in 1910 aggregating 5,427,953 tons, valued at $18,708,156, and averaging in value $3.45 per ton.

Production of gold, silver, copper, lead, and zinc in the West Mountain or Bingham district, Salt Lake County, Utah, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	73,599.47	$1,521,436	85,526.61	$1,767,992	+ 11,927.14	+ $246,556
Silver.....do....	1,615,394	840,005	1,800,410	972,222	+ 185,016	+ 132,217
Copper.....pounds..	92,560,340	12,032,844	113,725,280	14,443,110	+21,164,940	+2,410,266
Lead.....do....	30,365,819	1,305,730	30,271,016	1,331,925	− 94,803	+ 26,195
Zinc.....do....	649,542	35,075	3,572,347	192,907	+ 2,922,805	+ 157,832
Total.....	.....	15,735,090	.....	18,708,156	.....	+2,973,066

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The number of mines producing and the production of ore and its content in this district for six years is shown in the following table:

Number of mines producing and total tons of ore sold or treated in West Mountain or Bingham district in 1905–1910, and total content of gold, silver, copper, lead, and zinc.

Year.	Number of mines producing.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
		Short tons.	*Fine ounces.*	*Fine ozs.*	*Pounds.*	*Pounds.*	*Pounds.*	
1905	21	1,012,009	63,701.00	1,980,583	39,219,734	28,494,879	.....	$9,735,627
1906	25	996,121	78,986.03	1,927,350	39,424,276	22,927,661	.....	11,839,873
1907	29	1,503,082	75,730.24	1,796,580	45,431,964	21,971,064	.....	12,995,435
1908	27	2,691,640	60,382.69	1,053,146	71,155,740	15,169,518	.....	11,836,067
1909	24	4,166,992	73,599.47	1,615,394	92,560,340	30,365,819	649,542	15,735,090
1910	31	5,427,953	85,526.59	1,800,410	113,725,280	30,271,016	3,572,347	18,708,156

Ores were produced from 31 mines in 1910, as against 24 mines in 1909. The ore shipped to smelters in 1910 aggregated 496,773 tons, against 626,068 tons in 1909. The ores shipped to smelters in 1910 yielded 39,829.02 ounces of gold, 1,017,371 ounces of silver, 21,796,730 pounds of copper, 7,762,110 pounds of lead, and 50,917 pounds of zinc. Concentrates produced from ore milled in 1910 aggregated 237,541 tons, as against 196,485 tons in 1909 and 113,023 tons in 1908. The metallic yield of concentrate shipped to smelters in 1910 was 45,281.06 ounces of gold, 774,863 ounces of silver, 91,681,016 pounds of copper, 22,508,906 pounds of lead, and 3,521,430 pounds of zinc. Included with these concentrates were those resulting from the treatment of 2,767 tons of tailings. The zinc was produced from the ores of the Old Jordan and Galena mines and the Winnemuck property. The Utah Leasing Co. was the only shipper of gold bullion extracted from siliceous ores, mined from the United States property and treated in a cyanide mill. The production of different kinds of ore in 1910 is given in the following table:

Output of ore and production of metals in Bingham district, Utah, in 1910, by kinds of ore.

Kind of ore.	Number of mines producing.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Zinc.
Siliceous	3	8,208	1,171.24	92,208	133,223	242,146	.....
Copper	11	5,256,137	78,508.90	1,125,018	112,814,186	26,463	.....
Lead	23	76,338	2,170.19	343,352	448,892	17,832,536	.....
Zinc	1	78	4.95	569	623	15,046	38,617
Lead-zinc	2	87,192	3,671.33	239,263	328,356	12,154,825	3,533,730
Total	40	5,427,953	85,526.61	1,800,410	113,725,280	30,271,016	3,572,347

In comparing this table with that giving the output by different kinds of ore published in the 1909 mine report, a difference is found in the addition of zinc and lead-zinc ores, of which no production was made in 1909. Lead ore produced in 1909 was shipped to lead furnaces without preliminary treatment and the zinc content was lost. The combined output, as shown in the table for 1910, of lead and

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lead-zinc ore almost equals the output of lead ore in 1909, and besides making an interesting comparison shows what may be saved by electrostatic separators. Low-grade porphyry ore containing disseminated copper aggregated 4,780,949 tons and constituted 88 per cent of the total tonnage of the district. It was the source of 80 per cent of the copper, 47 per cent of the gold, and 21 per cent of the silver recovered. These ores were mined chiefly by steam shovels and hauled from the mines to the milling plants, 15 miles distant, owned by the Utah Copper Co. The concentration mill of the Ohio mine situated at Lark treated an important tonnage of monzonite porphyry ore during 1910, and supplied concentrate to the Garfield smelter. The shipments included the output of December, 1909, when the first unit of the plant began operation.

The Utah Copper Co., in its annual statement for 1910, gives interesting figures pertaining to the ore developed on its property, which includes the new acquisition, the Boston Consolidated group. Calculations are reported to show that, after deducting all ore mined up to January 1, 1911, there remains in the area in which the principal development work has been done 203,500,000 tons of fully and partly developed ore. Of this quantity 152,130,000 tons are reported as fully developed and blocked. In calculating the ore tonnages, 13 cubic feet of ore in place is taken as one ton. Of the fully developed ore, 60,000,000 tons have a reported average copper content of 2 per cent, and the remaining 92,130,000 tons of ore fully developed a content of 1.6 per cent of copper. The average assay of the partly developed ore is reported to show a content of 1.4 per cent of copper. The entire 203,500,000 tons of developed and partly developed ore therefore contains ore averaging 1.67 per cent in copper. As a check against the average percentages of copper stated, it is interesting to note that the average assay of the total 11,175,916 tons of ore mined and milled from the Utah and Boston groups, prior to the date of this report, was 1.64 per cent copper. During 1910 no ore was mined by underground methods from the original Utah Copper group, but the underground mining operations of the Boston mine were continued throughout the period. Of the total ore mined during the year 82 per cent was mined by steam shovels from the Utah mine and 18 per cent by underground methods from the Boston mine. The average cost of mining for the year was 40.97 cents per ton, of which 13.3 cents were charged to cover development and stripping expense, leaving a total cost for producing ore of 27.67 cents per ton. Of the 22 steam shovels on the property 2 are obsolete and are only used in emergency. The stripping, ore, and service tracks over and about the mines comprise a total of 32.62 miles of track. The tracks are owned by the Bingham & Garfield Railway. The Magna concentrator was operated continuously throughout 1910. The Copperton plant was permanently closed on August 1 and dismantled, and the machinery was taken to the Arthur plant to be used in remodeling it. Portions of the Arthur plant were operated intermittently during the year, as the tonnage produced was in excess of the present capacity of the Magna plant. On November 1 three of the 13 sections of the Arthur plant were permanently closed and partly dismantled for the purpose of remodeling them along the lines of the Magna plant; it having been determined, shortly after

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the acquisition of the Arthur plant from the Boston Consolidated Co., that the arrangement and methods employed at the Magna plant were distinctly more economical and efficient than those used in the Arthur mill. When the remodeling of the Arthur plant is completed it will have a capacity of approximately 8,000 tons a day, as compared with 3,000 tons for the old plant. The Magna plant has had its capacity increased to more than 10,000 tons per day, and, at the same time, its metallurgical results have been improved during 1910. The total tonnage treated at all plants for the year was 4,340,245 tons, of which the Magna plant milled 3,209,984 tons, the Arthur plant 936,900 tons, and the Copperton plant 193,361 tons. The average grade of the ore treated at all plants was 1.54 per cent copper, and the average extraction at all plants 66.55 per cent, equivalent to a recovery of 20.51 pounds of copper per ton of ore. The average cost of milling for all plants for the year was 46.63 cents per ton. The total production of copper contained in concentrates was 89,019,511 pounds, and the average grade of concentrates produced was 27.28 per cent of copper. The Bingham & Garfield Railway has been completed from a connection with the San Pedro, Los Angeles & Salt Lake Railroad near the town of Garfield to the Magna plant, a distance of about 2½ miles. The total length of the line to the mines is 20.1 miles. This road from mines to mills is approximately 10 miles shorter than the Denver & Rio Grande line, over which the ores are now being delivered.

Prospects at the Highland Boy mine, where there had been some unsatisfactory developments on its lower levels, improved toward the end of 1910, according to a printed statement issued by the company, and an ore body averaging 4.5 per cent of copper was opened. In 1910 the production aggregated 182,204 tons of sulphide ore, part going to the Garfield smelter and the rest to the Tooele smelter. The ore yielded 7,489,471 pounds of copper, 154,322 ounces of silver, and 14,802.31 ounces of gold. The ore reserves are estimated at 381,000 tons, averaging 2.44 per cent of copper, and 0.05 ounce of gold and 0.63 ounce of silver per ton.

The United States Mining Co. worked its Bingham properties during the year, and shipped from 260 to 350 tons daily. In November and December the output was 600 tons a day. The Telegraph mine was worked by lessees and also on company account. A 50-ton cyanide plant was built by the Utah Leasing Co. in order to treat siliceous gold-silver ores from this mine. According to the statement of the company [1] developments in the mines have been progressing with satisfactory results. The tonnage added during 1910 was greater than the tonnage extracted. Toward the end of the year a body of high-grade copper ore was uncovered. This is the first instance of such ore having been found in these properties, and while it is too early yet to estimate the extent of the deposit it is apparently of importance. The lead ore extracted from these mines during the year amounted to 87,168 tons. In addition there were 32,744 tons of low grade and 620 tons of high-grade copper-silver-gold ores shipped.

At the Utah Apex mine a number of new bodies of lead and copper ore were developed during the year. Some of these along the Dana fissure were opened for over 200 feet. The new occurrences of

[1] Annual Statement 1910, U. S. Mining Co.

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lead-silver ore making out along the limestone bedding from the fissures are of interest, as promising to open up large bodies of ore of this kind in a new section of Bingham. From 150 to 175 tons were mined daily up to November 10, when milling operations were suspended in order to develop several important discoveries.

The Dalton & Lark mine was operated all of 1910, but the commercial mine, under the same management, was closed in September, owing to the disposal of its surface rights in the Copper Center gulch to the Utah Copper Co. for dumping purposes. The statement [1] shows the Dalton & Lark to have produced 7,627 tons of lead ore and 4,909 tons of copper ore, which were shipped. The Commercial produced as shipping ore 12,463 tons of copper sulphide ore and 49 tons of lead ore. In the Lead mine a large body of siliceous silver-lead ore has been developed above the 950-foot level and has produced 3,935 tons. Active mining on the Lark vein disclosed 3,230 tons of lead and copper ores of shipping grade. The Brooklyn vein yielded two cars of lead ore.

Lessees at work on the Winnemuck in 1910 shipped several cars of lead-silver ore as well as some zinc ore. This property has quite an extensive zinc vein from which a good tonnage would be available with a little extra development.

Operators of the Yampa mine, on account of the reduction in the market price of copper, were forced to close their smelter at Bingham about the last of October. It was found that better results could be obtained by selecting and mining a smaller tonnage of higher grade ore and shipping to another smelter.

The Utah Metal Mining Co., which is driving the 11,000-foot drain and operating tunnel between Middle Canyon on the Tooele side of the range and Carr Fork at Bingham, completed the preliminary work on its plant, and advanced the tunnel about 1,800 feet since April, which made a total length of 4,500 feet at the end of 1910.

SUMMIT AND WASATCH COUNTIES.

The output of these counties combined represents the yield made by 16 mines in Summit County and 1 mine in Wasatch County, all within the area known as the Park City region. The metallic production of the region in 1909 and 1910 is shown in the following table:

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Summit and Wasatch counties, Utah, in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	4,814.18	$99,518	4,467.48	$92,351	− 346.70	− $7,167
Silver.....do....	2,825,385	1,469,201	2,571,771	1,338,756	− 253,614	− 80,445
Copper.....pounds..	1,655,749	215,247	1,423,629	180,801	− 232,120	− 34,446
Lead.....do....	46,350,390	1,993,067	38,129,761	1,677,709	−8,220,629	−315,358
Zinc.....do....	6,737,237	363,811	9,437,992	509,651	+2,700,755	+145,840
Total.....	.....	4,140,844	.....	3,849,268	.....	−291,576

[1] Annual Report, Bingham Mines Co., 1910.

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Snake Creek and Uinta district mines in the Park City region produced 215,339 tons of ore in 1910, against a production of 196,172 tons mined in 1909 and 142,331 tons in 1908. The quantities and values of all metals, with the exception of zinc, decreased in 1910. Mixed carbonate and sulphide lead ore was shipped to the smelters, aggregating 30,140 tons, which is a decrease from 42,710 tons shipped in 1909. Shipments of ore to the smelters in 1910 contained 2,445.90 ounces of gold, 1,269,890 ounces of silver, 778,259 pounds of copper, and 13,359,445 pounds of lead, valued in all at $1,422,957, at an average value of $47.21 per ton. The remainder of the ore mined, aggregating 175,830 tons, yielded 55,349 tons of concentrate, 2,021.57 ounces of gold, 1,301,881 ounces of silver, 645,370 pounds of copper, 24,770,316 pounds of lead, and 9,437,992 pounds of spelter, valued at $2,426,312 and at an average value of $43.84 per ton. In 1909 the average value of the shipping ore was $52.81 per ton and of the concentrates $37.71 per ton. According to a division of the output by classes of ore, 142,017 tons of lead-zinc ore were produced, containing 1,492.98 ounces of gold, 989,135 ounces of silver, 533,830 pounds of copper, 19,941,846 pounds of lead, and the entire zinc yield of the region. Lead ores aggregating 70,609 tons contained 2,021.94 ounces of gold, 1,513,444 ounces of silver, 866,793 pounds of copper, and 18,153,446 pounds of lead. From 2,713 tons of dry or siliceous ore there were recovered 952.56 ounces of gold, 69,192 ounces of silver, 23,006 pounds of copper, and 34,469 pounds of lead.

An important event was the consolidation of the West Quincy and the Thompson properties, both of which have been idle for some time. Another important project was the beginning of the Snake Creek tunnel, which will be 14,000 feet long when completed. In 1910 the tunnel was extended 2,360 feet. It will unwater a great section of the Daly Judge property and afford means for the development of a large amount of virgin ground. The Ontario tunnel is being extended to the end of the Daly Judge property. By extending the drift from the 1,550-foot level of the Daly West, the Daly Judge is afforded drainage to a depth of 1,950 feet and a shaft can now be sunk to what will be the 1,900-foot level.

According to the annual statement of the company, the Daly West mill was in operation during 1910, running part of the time for one shift a day. Lessees are working the larger part of the mine and most of the production came from these operations. Developments from the 1,700-foot to the 1,900-foot level were disappointing. The average assay per ton of the mill ore, crude ore, and concentrates shipped in 1910 was as follows:

Average assay per ton of mill ore, crude ore, and concentrates treated and shipped by the Daly West Mining Co., Utah, in 1910.

Kind of material.	Dry ore.	Gold.	Silver.	Copper.	Lead.	Zinc.	Value per ton.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Per cent.*	*Per cent.*	*Per cent.*	
Ore treated at mill	83,119	.....	8.93	.....	7.95	8.39	.....
Crude ore shipped	4,363	0.0405	51.70	1.82	18.97	.....	$21.66
Lead concentrate shipped	16,123	.0368	32.54	1.29	38.14	13.06	35.53
Zinc concentrate shipped	7,879	.....	17.42	.....	5.55	37.78	14.13

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Prospecting and exploratory work in the Daly Judge mine amounting to 5,649 feet was accomplished, and 47,002 tons of milling ore and 9,106 tons of shipping ore were produced. The mill is operated by electricity and was in service nearly the entire year, concentrating 6.03 tons of ore into 1 ton of lead concentrate. The last of the zinc middlings were hauled in July from the old dump to the Grasselli Chemical Co. dry concentrator. This company now takes the daily output of middlings from the Daly Judge mill, and also buys zinc middlings from the operators of numerous small wet concentrating plants working tailings. The Grasselli Co. is constructing a wet concentrator of its own to work a large bed of accumulated tailings on the flats below the dry concentrator.

Average metallic content per ton of crude ore and concentrates of Daly Judge Mining Co., Utah, in 1910.

Kind of material.	Tonnage.	Gold.	Silver.	Lead.	Copper.	Zinc.	Iron.	Value per ton.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Crude ore	9,106	0.078	39.57	23.36	1.59	10.50	9.58	$26.14
Concentrates	7,787	.059	23.60	31.80	.52	10.80	17.03	28.45
Zinc middlings	10,556	.022	8.18	4.08	.....	27.00	12.34	5.60
Iron middlings	2,511	.056	14.00	13.59	.45	12.49	25.90	12.94

The Silver King Coalition interests acquired the Uintah-Treasure Hill, which includes the Creole property, thus making further additions to its already large acreage. The total area now exceeds 2,200 acres. Early in 1910 the company cut down its output and has since given more attention to the developing of its ore deposits.

Lessees on the Ontario mine during 1910 shipped regularly. The average ore is said to show a fair profit.

TOOELE COUNTY.

In 1910 the production of 314,482 tons of ore was reported by 22 operators. This was 79,243 tons less than the production in 1909 by 24 operators. The ore mined in 1910 contained $721,361 in gold, 189,143 ounces of silver, 315,281 pounds of copper, 8,607,706 pounds of lead, and 2,843,032 pounds of zinc, valued in all at $1,395,802, at an average value of $4.44 per ton, as against $3.78 in 1909. The gold and silver value of this ore per ton was $2.45 in 1909, against $2.62 in 1910. Decreases in output for all metals except lead and zinc were shown, and the total value of the output decreased $94,294. Of the total ore mined, the larger part, aggregating 252,892 tons, was treated at milling plants using the cyanide process, and yielded bullion containing $715,972 in gold and 73 ounces of silver, with an average recovery of $2.83 per ton. The next largest tonnage, 26,315 tons of shipping ore, was sent directly to smelters and yielded $5,301 in gold, 187,228 ounces of silver, 308,132 pounds of copper, 8,543,219 pounds of lead, and 2,843,032 pounds of zinc, having a total value of $674,962, at an average value of $25.65 per ton. Concentration and jigging mills produced 109 tons of concentrate, yielding $62 in gold, 1,369 ounces of silver, 2,032 pounds of copper, and 48,935 pounds of lead, valued at $3,213, or an average value of $29.48 per ton. The

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Tooele smelter of the International Smelting & Refining Co. was completed and in operation in July, 1910. It is stated that provision is being made for the erection of lead furnaces in 1911.

Camp Floyd district.—In 1910 from 4 mines was reported an output of 287,646 tons of ore, treated entirely at milling plants using the cyanide process, which yielded $715,972 in gold and 73 ounces of silver, with an average recovery of $2.49 per ton. This output included the bullion recovered from 34,754 tons of old tailings re-treated.

The Consolidated Mercur, by careful work, made a profit of $16,537 on ore of a gross value of $613,148, of which about 638 tons per day were treated, the heads averaging $3.59; tails, 94 cents. The ore is continually becoming lower in grade. The Boston Sunshine mill at Mercur closed down about the middle of the year, after running 14 months and paying $19,500 in dividends.

Columbia district.—From a clean-up of the old Sharp mine, 150 tons of lead ore were shipped to smelters and contained a small quantity of gold and silver.

North Tintic district.—The production of ore, containing principally zinc, was made by the Scranton and Bullion mines.

Ophir district.—Through the operations of lessees and owners of mining properties, 18,266 tons of ore were produced, of which the larger part, or 18,032 tons, was shipped to smelters. The total metallic yield aggregated $4,767 in gold, 158,257 ounces of silver, 297,253 pounds of copper, and 6,943,846 pounds of lead, with a total value of $433,506, at an average value of $23.73 per ton. During 1910 the Cliff property produced from 1,500 to 2,000 tons of ore per month. The ores are carbonate of lead, running well in silver and carrying a high excess of iron. At the Ophir Hill property, which was rather quiet during 1910, plans have been perfected for a new drain tunnel, which will tap and drain the lower workings of the property, so that the search of ore at and below the present workings may be resumed.

Rush Valley district.—Seven mines produced 1,981 tons of ore, which includes 287 tons of old tailings re-treated, producing lead concentrate. The crude smelting ore aggregated 1,694 tons and contained 23.43 ounces of gold, 14,899 ounces of silver, 5,237 pounds of copper, and 921,247 pounds of lead.

Early in 1910 the Bullion Coalition Co. was formed and took over the old Honerine property, the Honerine Extension, and the Bullion properties. The company has settled for about 1,500 tons of ore for the year, part of which it mined itself. The bulk, however, was mined by lessees, of which there were eight sets at work. The management is now extending the big drain tunnel eastward and it is now in something over 12,000 feet.

Silver Islet district.—Only a small quantity of lead ore, containing some copper and considerable silver, was shipped from the district in 1910.

UINTA COUNTY.

Placer mining on Green River, near Jensen, 15 miles southeast of Vernal, has been carried on intermittently for several years. The Mitchell diggings during 1910 were the most productive because of improved methods of placering.

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UTAH COUNTY.

The production in 1910 aggregated 59,576 tons of ore, of which 56,496 tons was of shipping grade, and the remainder, 3,080 tons, was treated in a concentration mill. The ore shipped to smelters contained $190,499 in gold, 1,500,625 ounces of silver, 12,404 pounds of copper, and 18,806,301 pounds of lead, valued at $1,829,889, at an average of $32.39 per ton. The metallic content of the ore produced in 1910, as compared with the output of 1909, shows that there were decreases in output of all metals and that the total value decreased $1,544,916. The largest part of this decrease in value is for the silver and lead.

American Fork district.—Five mines yielded 965 tons of ore of shipping grade in 1910, as against 7 mines producing 1,025 tons of shipping ore in 1909. The metallic content of the 1910 output aggregated $3,785 in gold, 34,204 ounces of silver, 12,227 pounds of copper, and 519,749 pounds of lead, with a total value of $46,677, at an average value of $48.37 per ton. The total value in 1909 was $51,692, or an average value of $50.43 per ton.

Activity in the district was not as great as in the last few years. However, one property, the Dutchman lease, produced quite steadily and from the shipments was able to pay dividends. The most encouraging feature of the district is the advent of the United States Mining Co., which has taken a working bond and lease on the Mountain Dell property and is at work developing it. The outlook is encouraging, and if success is attained it will go far to revive the camp, which years ago was one of the best producers in the State. The Pacific mine and the Live Yankee were also on the shipping list in 1910.

Santaquin district.—Ore of almost pure galena, with good silver values, was shipped from the Union Chief mine.

Tintic district.—Under the Juab County heading will be found the figures for this district compared for 1909 and 1910 for Juab and Utah counties separately.

WASHINGTON COUNTY.

No production was recorded for Washington County in 1910.

WASHINGTON.

By C. N. Gerry.

PRODUCTION.

The mine production of gold, silver, copper, and lead in Washington for the calendar year 1910 had a total value of $968,249, an increase of $519,283, or nearly 116 per cent. There was a decrease in the copper production, but a greater increase in the gold, silver, and lead output than in any year during the last six. The production of gold and silver was more than double that of 1909, and there was a far greater increase in the quantity of lead. The gold production was 38,126.51 ounces; silver, 205,345 ounces; copper, 86,918 pounds; and lead, 1,322,287 pounds. Reports show a general increase in

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number of productive properties from 11 placers and 35 deep mines in 1909 to 21 placers and 55 deep mines in 1910. From these deep mines 59,209 tons of ore were produced, an increase of 22,901 tons. The ore was valued at $16.29 per ton for all metals, and at $15.12 per ton in gold and silver. Less than 4 per cent of the ore, or 2,089 tons, was treated in gold and silver mills, and contained gold and silver valued at $20,153, or $9.65 per ton. Aside from bullion, these mills made 23 tons of concentrates, containing $869 in gold and 82 ounces of silver. No mills using concentration alone were operated, but 3 amalgamation mills were active and 2 arrastres turned out bullion. Over 96 per cent of the ore mined was shipped without previous treatment to various smelters. This shipping ore had a gross average value of $16.51 per ton. Most of the ore was siliceous, and nearly all of it was mined in Ferry and Stevens counties.

Mine production of gold, silver, copper, and lead in Washington in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (—).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	17,514.22	$362,051	38,126.51	$788,145	+20,612.29	+$426,094
Silver.....do....	79,488	41,334	205,345	110,886	+ 125,857	+ 69,552
Copper.....pounds..	255,134	33,167	86,918	11,038	— 168,216	— 22,129
Lead.....do....	288,700	12,414	1,322,287	58,180	+1,033,587	+ 45,766
Total.....	.....	448,966	.....	968,249	.....	+ 519,283

The unusual increases of 1910 are shown by comparison with the production of the last six years.

Total tons of ore sold or treated in Washington in 1904–1910, and total content of gold, silver, copper, and lead.

Year.	Tonnage.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
1904.....	59,310	15,212.13	157,598	350,047	1,760,309	$518,019
1905.....	46,650	19,595.63	125,376	108,709	605,043	526,200
1906.....	27,133	10,722.22	45,878	235,030	926,100	350,533
1907.....	44,413	12,532.70	55,359	297,812	820,035	398,635
1908.....	37,633	11,718.07	88,823	312,030	1,150,429	378,816
1909.....	36,308	17,514.22	79,488	255,134	288,700	448,960
1910.....	59,209	38,126.51	205,345	86,918	1,322,287	968,249

GOLD.

From an output of 17,514.22 ounces, valued at $362,051 in 1909, the production was increased to 38,126.51 ounces, valued at $788,145 in 1910, an increase of 20,612.29 ounces in quantity and of $426,094 in value. Ferry and Stevens counties were, as in the past, the largest producers, but as the output of Stevens County greatly decreased, credit was due almost entirely to Ferry County and to the Republic district. King, Okanogan, and Chelan counties came next to Stevens in gold output, but with comparatively slight productions. Gold valued at $3,859 was derived from 21 placers, $113 came from copper ore, and the remainder, $784,175, was from siliceous ore. A decrease

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was recorded in output of placer gold. The ore shipped had a gold value of $13.37 per ton, and the ore amalgamated a value of $9.50 per ton in gold.

Source of gold production in Washington, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Total.
Asotin	3.29	.....	.....	3.29
Chelan	1.94	330.25	.....	332.19
Ferry	21.43	34,557.41	.....	34,578.84
King	.....	939.44	.....	939.44
Kittitas	151.94	21.67	.....	173.61
Okanogan	3.92	629.21	.....	633.13
Pierce	.....	.....	0.39	.39
Skagit	.....	.05	.....	.05
Snohomish	2.90	1.36	.....	4.26
Stevens	.....	1,455.05	5.00	1,460.05
Whatcom	1.26	.....	.....	1.26
Total	186.68	37,934.44	5.39	38,126.51

SILVER.

The silver production of Washington in 1910 was 205,345 ounces, valued at $110,886, as against 79,488 ounces, valued at $41,334 in 1909, an increase of 125,837 ounces in quantity and of $69,552 in value which is also to be credited to Ferry County. With the exception of 601 ounces in bullion, 82 ounces in concentrate, and 60 ounces from placers, the output was entirely from crude shipping ore, which averaged 3.58 ounces per ton. Ferry County took first place in silver production in 1909 and 1910, although Stevens County held that distinction in 1908 and Snohomish County in 1907.

Source of silver production in Washington, by kinds of ore, in 1910, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Total.
Chelan	.....	137	.....	.....	137
Ferry	10	185,347	.....	.....	185,357
King	.....	3,145	.....	.....	3,145
Kittitas	49	8	.....	.....	57
Okanogan	1	3,293	.....	23	3,317
Pierce	.....	.....	16	.....	16
Skagit	.....	3	.....	.....	3
Snohomish	.....	32	.....	.....	32
Stevens	.....	2,113	7,459	3,709	13,281
Total	60	194,078	7,475	3,732	205,345

COPPER.

The copper production in 1910 was 86,918 pounds, valued at $11,038, a decrease of 168,216 pounds in quantity and of $22,129 in value. In the last seven years the largest copper production was that of 1904, or 350,047 pounds. As to source, the production was about equally divided between copper ore and siliceous ore containing small percentages of copper. Most of the copper, or 98 per cent, came from Stevens County, and a great portion of the decrease was recorded in that locality.

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Source of copper production in Washington, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Siliceous ore.	Copper ore.	Lead ore.	Total.
Ferry	61	.....	.....	61
Okanogan	.....	.....	24	24
Pierce	.....	1,770	.....	1,770
Stevens	43,136	41,927	.....	85,063
Total	43,197	43,697	24	86,918

LEAD.

The output of lead for the year was 1,322,287 pounds, valued at $58,180, against 288,700 pounds, valued at $12,414 in 1909. The increase of 1,033,587 pounds in quantity and of $45,766 in value is to be credited almost entirely to Stevens County. Only a few pounds had their source in siliceous ore, the bulk being derived from lead ore.

Source of lead production in Washington, by kinds of ore, in 1910, by counties, in dry pounds.

County.	Siliceous ore.	Lead ore.	Total.
Ferry	128	.....	128
Okanogan	.....	248	248
Skagit	40	.....	40
Stevens	29	1,321,842	1,321,871
Total	197	1,322,090	1,322,287

MINING INDUSTRY IN WASHINGTON IN 1910.

In several of the districts of Washington there was marked activity in mining during 1910, resulting in increased production. In the Republic district of Ferry County the greatest progress was made. For the year 1910 most of the ore from the region was shipped to smelters, but two large custom cyanide plants were in course of construction, which are designed to treat ore of too low a grade to ship profitably. A large part of the ore went to the Tacoma smelter and part was shipped to the following smelters in British Columbia: Granby Consolidated Mining, Smelting & Power Co., Consolidated Mining & Smelting Co., and British Columbia Copper Co.

Mine production of gold, silver, copper, and lead in Washington in 1910, by counties.

County.	Tonnage.	Gold.		Silver.	
		Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*	
Asotin	.....	3.29	$68	.....	.....
Chelan	174	332.19	6,867	137	$74
Ferry	37,874	34,578.84	714,808	185,357	100,092
King	697	939.44	19,420	3,145	1,698
Kittitas	24	173.61	3,589	57	30
Okanogan	1,927	633.13	13,088	3,317	1,792
Pierce	20	.39	8	16	9
Skagit	1	.05	1	3	2
Snohomish	19	4.26	88	32	17
Stevens	18,473	1,460.05	30,182	13,281	7,172
Whatcom	.....	1.26	26	.....	.....
Total	59,209	38,126.51	788,145	205,345	110,886

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Mine production of gold, silver, copper, and lead in Washington in 1910, by counties—Continued

County.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Asotin					$68
Chelan					6,941
Ferry	61	$8	128	$5	814,913
King					21,118
Kittitas					3,619
Okanogan	24	3	248	11	14,894
Pierce	1,770	224			241
Skagit			40	2	5
Snohomish					105
Stevens	85,063	10,803	1,321,871	58,162	106,319
Whatcom					26
Total	86,918	11,038	1,322,287	58,180	968,249

Tonnage of ore sold or treated, number of deep mines producing, and value of ores in Washington in 1909 and 1910, by counties.

County.	Ore sold or treated.		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	1910	Increase (+) or decrease (−).	1909	1910	1909	1910	1909	1910
	Short tons.							
Chelan	174	+ 43	5	7	$32.77	$39.66	$32.77	$39.66
Clallam		− 3	1		13.00		13.00	
Ferry	37,874	+26,421	7	19	20.80	21.50	20.79	21.50
King	697	+ 425	1	1	40.02	30.30	40.02	30.30
Kittitas	24	− 97	2	4	2.85	18.83	2.85	18.83
Okanogan	1,927	+ 706	4	9	11.79	7.69	8.66	7.68
Pierce	20	+ 20		1		12.05		.85
Skagit	1	+ 1		1		5.00		3.00
Snohomish	19	− 4	1	1	30.78	2.37	2.65	2.37
Stevens	18,473	− 4,561	4	12	7.53	5.75	5.75	2.02
Whatcom		− 50	1		11.24		11.24	
Total	59,209	+22,901	26	55	12.20	16.29	10.94	15.12

[a] Value per ton, placer product excluded.

Tonnage of ores to gold and silver mills with gold and silver contained in bullion produced in Washington in 1910, by counties.

County.	Ore to gold and silver mills.		
	Quantity.	Gold in bullion.	Silver in bullion.
	Short tons.	*Fine ounces.*	*Fine ounces.*
Chelan	173	322.31	134
Ferry	68	83.91	24
Kittitas	24	21.67	8
Okanogan	1,824	531.35	435
Total	2,089	959.24	601

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Mine production of gold, silver, copper, and lead from Washington concentrates in 1910, by counties.

County.	Concentrates produced.					Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Chelan	2	2.05	.....	.....	.....	$42
Okanogan	21	40.00	82	.....	.....	871
Total	23	42.05	82	.....	.....	913

Mine production of gold, silver, copper, and lead from Washington crude ore shipped to smelters in 1910, by counties.

County.	Crude ore to smelter.					Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Chelan	1	5.90	3	.....	.....	$124
Ferry	37,806	34,473.50	185,323	61	128	812,717
King	607	939.44	3,145	.....	.....	21,118
Okanogan	103	57.86	2,799	24	248	2,721
Pierce	20	.39	16	1,770	.....	241
Skagit	1	.05	3	.....	40	5
Snohomish	19	1.35	32	.....	.....	45
Stevens	18,473	1,460.05	13,281	85,063	1,321,871	106,319
Total	57,120	36,938.54	204,602	86,918	1,322,287	943,290

Subdivision of tonnage, by kinds, of ore sold or treated from Washington in 1910, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Total.
Chelan	174	.....	.....	174
Ferry	37,874	.....	.....	37,874
King	607	.....	.....	607
Kittitas	24	.....	.....	24
Okanogan	1,926	.....	1	1,927
Pierce	.....	20	.....	20
Skagit	1	.....	.....	1
Snohomish	19	.....	.....	19
Stevens	16,145	799	1,529	18,473
Total	56,860	819	1,530	59,209
Average value per ton in gold and silver	$15.63	$5.06	$1.32	$15.18

There were no dredges in operation in Washington in 1910. There were 21 placers, of which 4 were drift mines and 17 were hydraulic or sluicing mines. The deep mines were classified as follows: Gold, 3; lead, 2; gold and silver, 38; gold, silver, and copper, 6; gold, silver, copper, and lead, 3; and silver, copper, and lead, 3.

REVIEW BY COUNTIES.

ASOTIN COUNTY.

Snake River district.—A small placer production was derived from the west bank of Snake River.

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CHELAN COUNTY.

Chelan County produced $6,867 in gold, and 137 ounces of silver. There were 174 tons of ore taken out by 7 operators and there were 2 producing placers. There was an increase of $2,648 in total value of output. The ore was mostly amalgamated and had a bullion value averaging $38.92 per ton.

Blewett district.—The Golden Eagle and the Blewett mines produced a little gold ore.

Chelan Lake district.—Production was 144 tons of ore, $6,090 in gold, and 123 ounces of silver, from 5 deep mines and 1 placer.

FERRY COUNTY.

Mine production of gold, silver, copper, and lead in Ferry County, Wash., in 1909 and 1910.

Metal.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	10,179.89	$210,437	34,578.84	$714,908	+24,398.95	+$504,471
Silver.....do....	53,694	27,921	185,357	100,092	+ 131,663	+ 72,171
Copper.....pounds..	606	79	61	8	− 545	− 71
Lead.....do....	.....	.....	128	5	+ 128	+ 5
Total.....	.....	238,437	.....	814,913	.....	+ 576,476

Over 84 per cent of the value of the output of the State had its source in Ferry County in 1910. There were increases of nearly 240 per cent in gold and of 245 per cent in silver over the figures for 1909. There were 37,874 tons of ore sold or treated by 19 operators, an increase of 26,421 tons in the quantity of ore and of 12 in the number of operators. This ore had an average value of $21.50 per ton in gold and silver. Except 68 tons treated in amalgamation mills, which had an average gold and silver value of $25.71 per ton, all of the ore was shipped to smelters.

Belcher district.—The Copper Key mine and the Belcher property were productive of some iron ore, which also contained gold and silver, and was used as a flux at the smelters.

Republic district.—In this district, 30 miles south of the Canadian line on the Great Northern Railway, 18 operators produced $713,604 in gold, 185,312 ounces of silver, 61 pounds of copper, and 128 pounds of lead. There were 33,781 tons of ore sold or treated, but practically all of it was smelted at Tacoma or by Canadian plants. The total value of the district output was $813,686, or more than three times the county output for 1909. In January the Republic Mines Corporation secured a lease on the Surprise, Lone Pine, and Pearl property and shipped, according to printed reports, 415 cars, or 19,350 tons, of ore, carrying from $20 to $45 per ton in gold and silver. From this group alone the value of the output exceeded that of the State output in 1909. Dividends amounting to $62,000 were paid, and over $200,000 was paid on the group, which was held on bond. This pronounced revival resulted in considerable shipments from 9 other mines in the district. The Insurgent, New

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Republic, Knob Hill, Ben Hur, Imperator Quilp, Hope, Tom Thumb, San Poil, and Phil Sheridan mines followed the Republic Mines Corporation in order of importance. A 1,000-ton cyanide plant was in course of construction by the North Washington Power & Reduction Co. and a smaller mill by the Pacific Ore Co. The object is to treat low-grade custom ore. A short article on the mines of the district appeared in the Mining and Scientific Press of August 13, 1910, and the geology was described by Umpleby in Bulletin No. 1 of the Washington Geological Survey, "Geology and Ore Deposits of Republic district."

KING COUNTY.

Miller Creek district.—Six miles from Berlin, at the head of Money Creek, the Apex Mining Co. shipped a siliceous ore of good grade.

KITTITAS COUNTY.

Swauk district.—The production of the Swauk district was $3,589 in gold and 57 ounces of silver from 12 placers and 4 deep mines. There was a decrease of $2,256 in value of total output. The placer product, valued at $3,167, was derived from 4 drift mines and 8 hydraulic mines.

OKANOGAN COUNTY.

In 1910 Okanogan County produced $13,088 in gold, 3,317 ounces of silver, and a few pounds of copper and lead, with a total value of $14,894, an increase of $475. The output of ore was 1,927 tons, at an average value of $7.69 per ton, of which 1,824 tons went to gold and silver mills, and 103 tons was crude ore shipped to smelters. The ore amalgamated had a bullion value of $6.15 per ton.

Myers Creek district.—From 3 deep mines and 1 placer the district produced $1,836 in gold and 28 ounces of silver. Development was continued at the Molson property, and tests were made in a 25-ton mill.

Palmer Mountain district.—The Ruby Mining Co., at Night Hawk, and the Hornsilver, at Oroville, made small shipments of silver ore.

Squaw Creek district.—The Hidden Treasure property at Methow produced a small shipment of rich gold-silver ore.

Wauconda district.—The Duluth-Toroda Mining Co., operating mine and mill at Bodie, marketed considerable bullion and some concentrate.

PIERCE COUNTY.

Carbon district.—The Washington-Wonder group at Fairfax produced copper ore taken out during development.

SKAGIT COUNTY.

Cascade district.—Only a trial lot of lead ore was shipped from mines at Rockport.

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SNOHOMISH COUNTY.

Index district.—A slight production of siliceous ore came from near Reiter.

STEVENS COUNTY.

Mine production of gold, silver, copper, and lead in Stevens County, Wash., in 1909 and 1910.

County.	1909		1910		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	5,877.47	$121,498	1,460.05	$30,182	− 4,417.42	−$91,316
Silver.....do....	21,571	11,217	13,281	7,172	− 8,290	− 4,045
Copper.....pounds..	220,146	28,619	85,063	10,803	− 135,083	− 17,816
Lead.....do....	288,677	12,413	1,321,871	58,162	+1,033,194	+ 45,749
Total.....	.....	173,747	.....	106,319	.....	− 67,428

The county sustained decreases in output of all metals but lead, but particularly in gold. There were 18,473 tons of ore produced, which had a total value of $5.75 per ton and a value of $2.02 per ton in gold and silver. The ore output decreased 4,561 tons, but there was an increase of 8 in the number of operators. All the ore was shipped crude to smelters. The tonnage was divided into 16,145 tons of siliceous ore, containing 1,455.05 ounces of gold, 2,113 ounces of silver, 43,136 pounds of copper, and 29 pounds of lead; 799 tons of copper ore, containing 5 ounces of gold, 7,459 ounces of silver, and 41,927 pounds of copper; and 1,529 tons of lead ore, containing 3,709 ounces of silver and 1,321,842 pounds of lead.

Bossburg district.—The Deer Trail property was active during three months and made a good output of lead ore.

Chewelah district.—The Chewelah Copper King and the United Copper were shippers of copper ore. The latter was operated continuously, while the former was practically idle.

Kittle Falls.—A small output came from the Ben Venue and the Columbia River mines, the former producing gold and silver and the latter copper.

Marcus district.—The Napoleon mine of the British Columbia Copper Co. produced a large tonnage of ore containing gold, silver, and a small quantity of copper. A 10-stamp mill was in course of construction for amalgamating and cyaniding ore from the oxidized portion of the ore body.

Northport district.—Four deep mines produced 810 tons of ore, containing $1 in gold, 214 ounces of silver, and 1,007,292 pounds of lead, in all valued at $44,438. This lead ore, containing little or no silver, was shipped to Missouri for smelting. The Jupiter was the principal producer.

Orient district.—The First Thought produced siliceous ore from January until July.

WHATCOM COUNTY.

Whatcom County, which formerly produced much placer gold, was practically unproductive in 1910.

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WYOMING.

By CHARLES W. HENDERSON.

PRODUCTION.

The total value of the production of gold, silver, and copper in the State of Wyoming in the calendar year 1910 was $32,234, a decrease of $36,794. The gold yield was 154.75 fine ounces, valued at $3,199; the silver yield was 1,478 fine ounces, valued at $798; and the copper output was 222,339 pounds, valued at $28,237. There were 12 producing mines, of which 8 were deep and 4 placer.

Mine production of gold, silver, and copper in Wyoming in 1909 and 1910.

Metal.	1909		1910		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	197.66	$4,086	154.75	$3,199	42.91	$887
Silver.....do....	1,754	912	1,478	798	276	114
Copper.....pounds..	492,539	64,030	222,339	28,237	270,200	35,793
Total.....	.....	69,028	.....	32,234	.....	36,794

The tonnage sold or treated was 1,474 short tons, as compared with 2,393 tons in 1909, and with 19,031 in 1908. In 1910 siliceous ore mined and treated amounted to 504 tons, the remainder of the tonnage, 970 tons, being copper ore. Deep mines yielded $2,545 in gold, 1,476 fine ounces in silver and 222,339 pounds of copper, or an average of $1.73 in gold and 1 fine ounce in silver, per ton. Copper ore proper yielded 11.5 per cent of copper.

The copper yield, valued at $28,237, represented 87.6 per cent of value of the State total.

The following table shows the total output of copper in Wyoming since 1881, when copper was first discovered in the State.[1]

Production of copper in Wyoming since 1881.

	Pounds.		Pounds.
1882	100,000	1898	233,044
1883	962,468	1899	3,104,827
1884	.....	1900	4,203,776
1885	.....	1901	2,698,712
1886	.....	1902	889,228
1887	.....	1903	1,023,189
1888	232,819	1904	3,565,629
1889	100,000	1905	2,530,531
1890	.....	1906	106,177
1891	.....	1907	3,026,004
1892	.....	1908	2,416,197
1893	.....	1909	433,672
1894	.....	1910	217,127
1895	.....		
1896	.....	Total	25,843,400
1897	.....		

[1] Kirchhoff, C., jr., The copper industry of the United States: Mineral Resources for 1881–1882, U. S. Geol. Survey, 1883, p. 229.

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MINING INDUSTRY IN WYOMING IN 1910.

In point of production of gold, silver, and copper, mining in Wyoming in 1910 was at its lowest ebb since 1906. Albany County, as in 1909, was the chief county in which these three metals were produced, principally from the operations of the Rambler Copper & Platinum Co., at Holmes. There was a larger tonnage of ore sold or treated from the Atlantic and Copper Mountain districts, of Fremont County, but the content was less than in 1909. There were small increases in placer yield in Crook and Uinta counties, but the decrease in placer production at Holmes, in Albany County, caused a falling off in the total placer yield of the State. Present development in Wyoming seems to promise a larger output of precious metals, including placer gold and copper, within the next few years.

Source of gold and silver production in Wyoming in 1909 and 1910.

Source.	Number of mines.	Tonnage.	Gold.		Silver.		Total value.
			Quantity.	Value.	Quantity.	Value.	
Deep mines:		*Short tons.*	*Fine ounces.*		*Fine ounces.*		
Siliceous ore	6	504	80.98	$1,674	169	$91	$1,765
Copper ore	2	970	42.13	871	1,307	706	1,577
Total, 1910, deep mines.	8	1,474	123.11	2,545	1,476	797	3,342
Deep mines, 1909	6	2,393	143.77	2,972	1,742	906	3,878
Increase (+) or decrease (−)	+2	−919	−20.66	−427	−266	−109	−536
Placer mines, 1910	4	.....	31.64	654	2	1	655
Placer mines, 1909	3	.....	53.89	1,114	12	6	1,120
Increase (+) or decrease (−)	+1	.....	−22.25	−460	− 10	− 5	−465
Total, 1910, deep and placer mines	12	1,474	154.75	3,199	1,478	798	3,997

REVIEW BY COUNTIES.

ALBANY COUNTY.

As in 1909, the Rambler Copper & Platinum Co., operating the Rambler mine, at Holmes, was the principal operator in Albany County and in Wyoming in 1910. Erection of a 50-ton concentrating plant at Holmes for treating copper-platinum ores was begun in April, 1910, but no copper concentrates were shipped, crude ore only being shipped in 1910 to Omaha. Before the end of the year the company was engaged in experimental milling operations, and it was reported that concentrates were shipped early in 1911. Assays of concentrates produced in experimental work show copper from 13.2 to 13.7 per cent and platinum from 8.64 to 15.2 ounces per ton.[1]

A test shipment of copper ore was made from the Barber prospect, in the La Plata, or Centennial, district.

Development work was done by the Jupiter, the Annie, the Wyoming Queen, the Commercial Gold, the North Fork, the Topeka

[1] Platinum in Wyoming: Eng. and Min. Jour., March 4, 1911, p. 460. Concentration of platiniferous copper ore at the Rambler mine, Wyo.: Metall. and Chem. Eng., February, 1911, pp. 75–78.

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Gold-Copper, the Boston-Wyoming Copper, and the Utopia mining companies, and by the owners of the Fram, the True Blue, and the Mosquito mines.

BIGHORN COUNTY.

The mining districts included in this county in 1909 are now in the newly created Park County.

CARBON COUNTY.

In the Elk Mountain district, near Arlington, the Big Five Copper and the Elkhorn Mining & Milling companies took out ore in 1910. Development work was done by the Walcott and the Wood Mountain copper companies.

In the Seminole district, near French, the Homestake Mining Co. sunk a shaft 52 feet and drove 75 feet of tunnel.

Near Dillon are several prospects. The Leighton-Wyoming Mining Co. erected a hoisting plant and sunk 60 feet of shaft.

There was little done in the Encampment district. The mines and smelter of the former Penn-Wyoming Co. were idle.

Some development work was done on mines near Saratoga and near Slater.

CROOK COUNTY.

There was an increase of placer gold from the mines in Hurricane district, northwest of Tinton, S. Dak. The output from three mines in 1910 was $211 in gold.

In the Bear Lodge district, northwest of Sundance, gold is found in fissures, in the Tertiary monzonite and syenite porphyries.[1] There was some development work on the properties of the Bear Lodge Gold Mining Co., on the Copper Prince mine, and on the mines of the Warren Peak Mines Co., for which a cyanide plant was in progress of erection.

FREMONT COUNTY.

In 1910 there was 504 tons of ore from Fremont County sold or treated from five mines, from which ore there was recovered $1,674 in gold, 169 fine ounces of silver, and 165 pounds of copper, with a total value for the three metals of $1,786, as compared with $2,456 in 1909 and with $5,583 in 1908.

Atlantic City (South Pass) district.—The greater part of the ore from the Atlantic City district was shipped to the smelter at Omaha. A small tonnage was treated in the 10-ton Huntington mill on the Mary Ellen mine. Considerable development work was done on the Duncan mine, which is opened by an incline shaft 170 feet deep and a tunnel 225 feet long, on the Big Chief mine, and on the Glendale group. The Federal Gold Mining Co., formerly known as the Carissa Co., continued development work on its property and reported considerable ore blocked out. The 10-stamp plate-amalgamation mill, with concentrators and Frue vanners, was used to make tests on the ore. The X. L. Gold Dredging Co. continued to construct

[1] Darton, N. H., Sundance folio (No. 127), Geol. Atlas U. S., U. S. Geol. Survey, 1905.

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ditches and reservoirs and to lay pipe in preparation for hydraulicking and dredging its 1,440 acres of placer property near Atlantic City.

Copper Mountain district.—Crude ore was shipped by the Wind River Mining & Milling Co. Several other lots of ore were shipped from Shoshone station. Development work was done on several properties near Shoshone and Deer Pass.

In December grading was finished on the railroad grade between Thermopolis and Powder River, which is part of the proposed link of the Burlington Railroad, which will give a direct line between Galveston and Puget Sound. Completion of the railroad should promote shipping from the Copper Mountain district.

Dredges on Bighorn River and tributaries.—The Shoshoni Gold Dredging Co. has let the contract for the construction of a dredge to be located on Bighorn River near Shoshone. The Fremont Dredging Co. had in prospect erection of a dredge early in 1911, on Big Wind River, near Riverton.

JOHNSON COUNTY.

There was no production in this county in 1910. Development work was done on the properties in the Bull Camp district, southwest of Buffalo.

LARAMIE COUNTY.

There were no shipments from Laramie County in 1910. Copper ore was put on the dump of the Hynds mine, near Hartville. In the Rawhide Buttes district, 12 miles south of Lusk, the Alta Mining & Milling Co. did development work. The Copper Belt Mines Co. was developing the Copper Belt group and the Michigan group and has a 640-foot shaft and 1,500 feet of tunnels on the property. The ore bodies occur as lenses, stringers, and veinlets, interbedded in pre-Cambrian limestone and schist.[1] Development work was also done at the Copper Bottom and the Grim Hope mines.

Some development work was done in the Silver Crown district, 20 miles west of Cheyenne.

PARK COUNTY.

Sunlight district.—The Sunlight district is 38 miles northwest of Cody. The ores usually occur along lines of contact between syenite and syenite porphyries and intrusive dikes. These dikes frequently penetrate the surrounding breccia, in which case the ores are found along the contact between the dikes and the breccia. The ores are mainly sulphides of copper and lead carrying silver.[2] The Winona Gold & Copper Co., during 1910, built a steam and electric plant and a sawmill. An adit has been run 769 feet. The company has in prospect the erection of a smelter. Between Painter and Cooke, Mont., are said to be several prospects of gold, silver, and copper.

Wood River (Kirwin) district.—Nothing but development work was done in 1910.

[1] Ball, Sydney H., Copper deposits of the Hartville uplift, Wyo.: Bull. U. S. Geol. Survey No. 315, 1907, pp. 106–107. See also Hartville folio (No. 91), Geol. Atlas U. S., U. S. Geol. Survey, 1903.

[2] Hague, Arnold, Absaroka folio (No. 52), Geol. Atlas U. S., U. S. Geol. Survey, 1899.

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SHERIDAN COUNTY.

There was a very small shipment of copper ore from near Sheridan in 1910. Development work is reported from the Black Mountain and Mohawk districts.

UINTA COUNTY.

Placer gold was recovered from the Buffalo placer in the Jackson Hole district by sluicing. Some development work was done by the Western Wyoming Copper Co., near Big Piney.

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SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES IN 1910.

(MINE PRODUCTION.)

By B. S. BUTLER and J. P. DUNLOP.

INTRODUCTION.

By J. P. DUNLOP.

The following is an account of the production of silver, copper, lead, and zinc in 1910 by the mines of the Central States, including Arkansas, Iowa, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, excluding the Black Hills. Most of the mines are developed in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

The statistics of production in this country have been compiled by the United States Geological Survey from confidential reports by each mine in operation and represent the quantity of metals recovered or paid for in the ore that was treated or sold during the year.

Statistics of mine production were first collected for Michigan for 1906. The mine census of all of the Central States was first undertaken for the year 1907. Its continuation for the year 1910 makes possible the direct comparison of the production for three successive years, which has been made in the following pages. A comparison of the total production of lead and zinc by States as reported by the mines and by the smelters will be found in the chapters on those metals in the complete volume.

The method of marketing and recording the mine output in the lead and zinc regions of the Central States differs from that employed in the Western States. In the Western States the miner usually sells his ore according to the assay content of metal at a certain price per unit. In the lead and zinc regions of the Central States, however, where the material sold is principally concentrates,[1] payment is made according to a basis price for a certain quality of concentrate. The details of this method are given in the pages devoted to Missouri. The figures reported to the Survey by producers represent the tonnage and assay content of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

[1] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore."

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The mines in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted. In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced during the year, but not smelted, has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF LEAD AND ZINC ORES OF THE CENTRAL STATES.

Much of the ore mined in the Western States is crude smelting ore—that is, it can be smelted directly without preliminary concentration. All but a very small portion of the ore from the Central States is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining operations in different States is that of tonnage of crude ore, or "dirt," as it is usually called in the Central States lead and zinc regions. However, in those States it is only the larger companies which make any record of the crude ore raised. In the Joplin region the number of cans of ore hoisted is usually recorded and the approximate weight of the cans is generally known. Thus each company knows, in a general way, about what percentage of concentrates the mine run is yielding. Knowing the total production of concentrates and the average yield of concentrates from crude ores, one can arrive at a close estimate of the crude ore raised. The quantity of crude lead and zinc ores raised has been requested annually on the United States Geological Survey schedules since the mine census was undertaken in the Central States in 1907, and for many of the mines it has been reported. Only the actual operating companies have the data, however, and it is the practice of the Geological Survey, in order to shorten the list of producers as much as possible, to send requests only to the owners of the mining land, or the companies holding first leases, and to depend upon them to report the whole production of the tract. In this way the crude ore reported has represented such a small fraction of the total that it has not been considered advisable to publish it. For 1909, however, the general census necessitated a report from every operator and the data in regard to crude ore are so much more complete that the average percentage of concentrates in the crude ore has been calculated from those schedules in which the crude ore is given. This has been done for each State, and in Missouri separate calculations have been made for the "soft ground" and the "sheet ground" of southwest Missouri and for the disseminated lead ore of southeast Missouri. These average percentages have been applied to the total concentrates produced, thus working back to the total quantity of crude ore raised. On comparison with similar average percentages gained from the more limited data received in the Mineral Resources canvass for 1908, there was found to be a very fair agreement. Therefore the calculations have been carried forward to include the year 1910, and the tables of ore tenor which follow in the sections devoted to the respective States show the comparative percentages for the two years. In certain States, notably Iowa, Kentucky, and the southern part of Illinois, it was not possible or advisable to make such calculations

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In Kentucky and southern Illinois, the lead and zinc ores are recovered as by-products in the concentration of the fluorspar which they accompany. In Iowa, in 1909 and 1910, the quantity of ore raised was so small and the number of producers so limited that the calculation of averages and of the crude-ore production would be misleading.

Tenor of copper, lead, and zinc ores of Central States.

State.	1909		1910	
	Crude ore.	Metal content.[a]	Crude ore.	Metal content.[a]
	Short tons.	*Per cent.*	*Short tons.*	*Per cent.*
Arkansas	12,800	4.7	35,000	3.4
Illinois (northern)	73,875	4.2	110,078	3.8
Kansas	595,736	2.4	704,046	2.5
Michigan	11,429,394	1.06	10,869,561	1.025
Missouri	11,480,654	2.6	12,748,420	2.3
Oklahoma	317,574	3.9	223,212	4.0
Wisconsin	696,389	4.3	1,032,031	3.6

[a] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in the other Central States the metals are lead and zinc, the relative proportions of which are shown in the table on another page, and in the tables of ore tenor given in the sections devoted to the respective States.

PRODUCTION.

SILVER.

The production of silver in the Central States in 1910 was 365,702 fine ounces, which, at the average price of 54 cents per fine ounce, had a value of $197,479, as compared with 301,629 fine ounces, valued at $156,848, in 1909. No silver ores are worked in the Central States, and the comparatively small quantity of silver that is produced is recovered incidentally to the production of other metals. The greater part of the output comes from the copper lodes of Michigan, but lead ores of southeast Missouri and the lead-zinc-fluorspar deposits of the Kentucky-Illinois field also carry silver, some of which is recovered from the lead concentrates.

COPPER.

Michigan and Missouri were the only producers of copper in the Central States in 1910, the former State contributing nearly the entire output. The copper production of Michigan in 1910 was 222,683,461 pounds, which, at the average New York price of 12.7 cents per pound, was valued at $28,280,800, as against a production of 234,136,529 pounds, valued at $30,437,749, in 1909. The copper produced in Missouri in 1910 amounted to 94,452 pounds, valued at $11,995, and was derived from concentrates recovered in treating lead ores of southeast Missouri.

LEAD.

The mine production of lead by the mines in the Central States in 1910 was 171,226 short tons, which, rated at the average New York price of the metal for the year of 4.4 cents per pound ($88 per ton),

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was valued at $15,067,888, as compared with 168,221 short tons, valued at $14,467,006, in 1909. Missouri, as usual, leads the other Central States in the production of lead, and repeated the record made in 1907, 1908, and 1909 by again taking first place in the United States. The disseminated lead district of southeast Missouri exceeded the production of the Cœur d'Alene district of Idaho and remains the largest single lead-producing district in the United States.

ZINC.

The production of zinc in the Central States in 1910 based on mine returns, with a deduction for smelting loss, was 178,784 short tons valued at $19,308,672. The value was computed at 5.4 cents per pound, or $108 per ton, the average St. Louis price for the metal. The 1909 production was 175,337 short tons, valued at $18,936,396. Missouri was again the largest producer of zinc in the United States.

SUMMARY OF PRODUCTION BY STATES.

The total value of the production of silver, copper, lead, and zinc in the Central States in 1910 was $62,866,834, as compared with $63,997,999[1] in 1909. The contributions of each State and each metal to this total are shown in the following table:

Production of silver, copper, lead, and zinc in the Central States in 1910, by States.

State.	Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Pounds.*		*Short tons.*		*Short tons.*		
Arkansas					63	$5,544	994	$107,352	$112,896
Illinois	2,022	$1,092			373	32,824	3,549	383,292	417,208
Iowa					20	1,760	96	10,368	12,128
Kansas					2,412	,212,256	13,229	1,428,732	1,640,988
Kentucky	84	45			41	3,608	6	648	4,301
Michigan	330,500	178,470	222,683,461	$28,280,800					28,459,270
Missouri	33,096	17,872	94,452	11,995	161,016	14,169,408	128,589	13,887,612	28,086,887
Oklahoma					2,888	254,144	6,394	690,552	944,696
Wisconsin					4,413	388,344	25,927	2,800,116	3,188,460
Total	365,702	197,479	222,777,913	28,292,795	171,226	15,067,888	178,784	19,308,672	62,866,834
Total, 1909	301,629	156,848	234,136,529	30,437,749	168,221	14,467,006	175,337	18,936,396	63,997,999
Total, 1908	292,237	154,885	223,286,700	29,473,844	153,361	12,882,324	146,975	13,815,650	56,326,703

[1] Not including value of copper production of Missouri.

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ARKANSAS.

By J. P. DUNLOP.

PRODUCTION.

The production of lead and zinc in Arkansas in 1910 is shown in the following table:

Production of lead and zinc in Arkansas in 1910, in short tons.[a]

District.	Ore.						Metal content.			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
	Galena.		Sphalerite.		Silicate and carbonate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
North Arkansas:										
1910	80	$3,714	1,857	$74,136	128	$2,641	63	$5,544	994	$107,352
1909	30	1,800	896	33,948	98	2,736	24	2,064	510	55,080
1908	18	985	516	18,270	939	21,469	15	1,260	605	56,870

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses in case of zinc, but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York and St. Louis.

Tenor of lead and zinc ore and concentrates produced in Arkansas, 1909–10.

		1909	1910
Total crude ore	short tons.	12,800	35,060
Total concentrates in crude ore	per cent.	8.0	5.9
Lead	do.	.2	.2
Zinc	do.	7.8	5.7
Metal content of crude ore	do.	4.7	3.4
Lead	do.	.2	.2
Zinc	do.	4.5	3.2
Average lead content of lead concentrates	do.	80.0	78.8
Average zinc content of sphalerite contentrates	do.	60.3	58.1
Average zinc content of zinc silicate and carbonate	do.	39.8	39.1
Average value per ton of lead concentrates		$60.00	$46.43
Average value per ton of sphalerite concentrates		$37.89	$39.92
Average value per ton of zinc silicate and carbonate		$27.91	$20.63

NORTHERN ARKANSAS.

Lead and zinc deposits have been known in Arkansas for many years. Lead was noted by Schoolcraft in his travels in 1819, and has been mined in a desultory way since the settlement of the State. Present development dates from about 1899, when there was a great rush to the northern Arkansas field. The mines are principally in Marion County and in the adjoining portions of Searcy, Newton, and Boone counties, though there are also numerous mines and prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and a deposit has recently been developed in Washington County, on the extreme west border of the State.

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The ores are galena, sphalerite, and smithsonite. The sphalerite is generally very high grade, the concentrates, when clean, ranging well above the price basis, 60 per cent metallic zinc content. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, a yellow variety of smithsonite, known locally as "turkey fat," showing as high as eight-tenths of 1 per cent of cadmium. The ore bodies occur in fissures or crevices, in fault breccias, and in solution breccias. The ore deposits are for the most part found in the Yellville limestone of Ordovician age, but some also are found in the Boone formation, of lower Carboniferous age.

Until recently the mines labored under the disadvantage of a long wagon haul to the railroad and of high freight rates. Other handicaps are the lack of keen competition among ore buyers and the added cost and the loss of time in obtaining supplies and repairs, though these conditions will doubtless improve with the development of the field. The completion of the White River branch of the St. Louis, Iron Mountain & Southern Railway and of the St. Louis & North Arkansas Railroad has brought most of the producing mines within 10 miles of railway transportation and greatly improved the situation in this regard. Land for mining purposes is ordinarily leased in 10-acre tracts at 10 per cent royalty. Wood is universally used for fuel at the mines. Since 1907 the number of steam concentrating plants in the northern Arkansas region has always been above 20, but usually not more than a third of them has been in operation in any one year. These are of the Joplin type, and average about 100 tons in daily capacity. Mining methods are similar to those in vogue in the Joplin region, except that, owing to the rugged character of the country, many deposits have been found outcropping on the hillside and have been followed in by tunnels. Shallow deposits are won by open pits. Hand drills are generally used, though a few of the larger plants have installed air or steam drills. Prospecting is done by means of the churn drill, and an encouraging feature of recent work has been the greater depth to which prospecting has been carried.

The assistance rendered by Prof. R. W. Willett in the preparation of this account of the lead and zinc production of Arkansas is gratefully acknowledged.

In 1910 there were 10 shippers of lead or zinc concentrates, and the quantity and value of the concentrates was about double that for the year 1909. Development both in mines and equipment was also much more active, though operators complained regarding lack of proper shipping facilities and low ore prices.

REVIEW BY DISTRICTS.

Dodd City.—No sales of concentrates were reported for 1910, the only active mine being that of the Pilot Rock Lead & Zinc Co., which was sinking a shaft on the Copperhead claim. The Susquehanna, Beatty, Bear Hill, Boone County, Nakomis, and Iola Cooperative mines were all idle.

Kingdon Springs district.—The Erie Ozark Mining Co. sold a small quantity of zinc concentrates produced in 1909, but the mine was not operated, nor were the other mines in this vicinity.

Maumee district.—The Maumee mine of the North Arkansas Mining & Investment Co. made the second largest shipment in the State.

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The crude ore runs about 5 per cent in zinc and the concentrates average 60 per cent. Considerable development was done underground, and the mill was equipped with new jigs and rolls. The Jack Pot, situated on the West Branch of Buffalo River, was also a shipper. This mine was worked by means of an open cut, the top of which is 45 feet higher and the lowest workings are 4 feet lower than the river bed. Three shallow shafts averaging 30 feet each were sunk on the Everett mine. All were in ore, but no concentrates were made.

Mine owners in the district are of the opinion that with electric power derived from Buffalo River, and the construction of a short branch railway to intersect the White River & Missouri Railway, the mines in this district would prove remunerative.

Mount Hersey and Cave Creek district.—Most of the lead ore and zinc silicate produced in Arkansas during 1910 was obtained by lessees on the properties of the Granby Mining & Smelting Co. from shallow shafts. None of the other mines in the district were operated.

Rush Creek district.—The Red Cloud Mining Co. was the largest producer of zinc concentrates in Arkansas in 1910. The company has a 200-ton concentrating plant and ships high-grade concentrates. The Silver Hollow Consolidated Zinc Co. made no shipments, being engaged in constructing a 100-ton mill of the Joplin type, a 400-foot aerial tramway, and other mine equipment. The old Philadelphia mine was operated by the Yellow Jacket Mining Co., which built a 100-ton concentrating plant. Some carbonate ore averaging 35 per cent zinc was shipped by C. A. Mulholland from Morning Star No. 1 and from the Ott mines. The mines were operated by means of open cuts or short tunnels. Both zinc carbonate and sphalerite were mined, but the sphalerite was stored until a concentrating plant can be erected.

Zinc and Sugar Orchard districts.—The only shipments in 1910 were a small quantity of lead ore from the Washington mine and some zinc concentrates from the Tar Kiln mine of the Federal Exploration & Development Co., which is equipped with a 100-ton plant.

The Madison 100-ton concentrator, the 50-ton mill of the Coon Hollow, and the 150-ton mill of the Gloria at Smithville were all idle.

The Lincoln Mining & Milling Association sunk their shaft on the New Era mine to 93 feet and put the 100-ton mill in condition for active work.

The Powhatan Zinc & Lead Mining Co. continued to develop their property. They reported 22 drill holes in ore and 3 shafts being sunk, the deepest one being down 183 feet.

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ILLINOIS.

By J. P. DUNLOP.

PRODUCTION.

The production of lead, zinc, and silver in Illinois in 1910 is shown in the following tables:

Production of lead and zinc in Illinois, in 1910, in short tons.[a]

District.	Ores.				Metal content.			
	Lead concentrates, galena.		Zinc concentrates, sphalerite.		Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Northern Illinois:								
Galena and Sand Prairie	126	$6,849	9,871	$249,496	101	$8,888	3,549	383,292
Southern Illinois	398	17,470	.....	.....	272	23,936	.....	.....
State, total	524	24,319	9,871	249,496	373	32,824	3,549	383,292
Total, 1909	372	19,122	5,206	165,099	295	25,370	2,163	233,604

[a] Owing to the fact that in 1910 there was but one producer in the Elizabeth-Sand Prairie district, the production is not given by districts in order to avoid disclosing individual business. In calculating the metal content of the ores from assays allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York and St. Louis.

Production of silver in southern Illinois, 1909–10.

Year.	Silver.		Lead concentrates, silver-bearing.	
	Quantity.	Value.	Quantity.	Ounces of silver per ton.
	Fine ounces.		*Short tons.*	
1909	1,011	$526	259	3.903
1910	2,022	1,092	398	5.08

Tenor of lead and zinc ore and concentrates produced in Illinois, 1909–10.

	1909	1910
Northern Illinois:		
Total crude ore.....short tons..	73,875	110,078
Total concentrates in crude ore.....per cent..	7.2	9.0
Lead.....do....	.2	.1
Zinc.....do....	7.0	8.9
Metal content of crude ore.....do....	3.4	3.8
Lead.....do....	.1	.1
Zinc.....do....	3.3	3.7
Average lead content of lead concentrates.....do....	77.9	80.2
Average zinc content of sphalerite concentrates.....do....	47.2	44.2
Average value per ton of lead concentrates	$48.64	$54.36
Average value per ton of sphlaerite concentrates	$31.71	$25.28
Southern Illinois:		
Average lead content of lead concentrates.....per cent..	62.7	68.3
Average value per ton of lead concentrates	$39.45	$43.89

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The lead concentrates produced in southern Illinois are recovered in concentrating the fluorspar. To speak of the total crude ore raised as crude lead ore would be misleading. No attempt has been made, therefore, at calculating the tenor of the crude ore.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineralogical association and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS.

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwest county of the State. The ores have the same structural relations as in the upper Mississippi district generally; that is, they occur disseminated through the limestone, or in openings in it called "crevices," "pitches," or "flats," depending on their attitude to the horizontal. These openings have in general an east and west trend, known as their range. The ore bodies are sometimes continuous for long distances along these ranges, which for that reason largely control the prospecting, both by shafts and by drilling. The ore deposits occur in the Galena dolomite and in the upper part of the Platteville limestone, both of Ordovician age. The ores are galena, sphalerite, and smithsonite, though the latter is much less common now than formerly, when the deposits worked were mostly shallow and above water level. The galena is practically non-argentiferous, and the zinc ores are not known to contain cadmium. Iron pyrites are very commonly associated with the ores, frequently in such quantity as to necessitate roasting and magnetic separation. Some of the concentrating plants have calciners or roasters attached, and there is a custom roaster operated by the Joplin Separator Co., at Galena, as well as custom roasters near by in Wisconsin and the electrostatic separator of the American Zinc Ore Separating Co., at Platteville, Wis.

The production of zinc blende concentrates in 1910 showed an increase of 4,665 tons over that of 1909, but the average value per ton of the concentrates declined from $31.71 to $25.58.

REVIEW BY DISTRICTS.

Elizabeth and Sand Prairie districts.—The only mine reporting any 1910 sales was that of the Royal Princess Mining Co., in the Sand Prairie district. This property, which has a 280-foot shaft and a concentrator of 100-tons capacity, was operated for a portion of the year.

Galena district.—This district includes the mines in the vicinity of Fever River, from the Mississippi River to the Wisconsin State line. Though formerly a large producer of lead the quantity of that metal now mined is comparatively small and zinc ores now form the principal output of the mines in the district. The largest producer of zinc concentrates in Illinois was the Vinegar Hill Zinc Co., and the most of this ore was produced from the Vinegar Hill mine. The shaft on this property is 175 feet deep, and the mine is equipped with a 100-ton concentrating plant. The Unity mine, also operated by this com-

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pany, has a 100-ton mill. During the year the use of steam power was discontinued and both mills were supplied with electric power from the Interstate Light & Power Co.

The Northwestern Zinc Co. sold a large quantity of low-grade blende concentrates. The property is equipped with a concentrating plant having a capacity of 150 tons for 10 hours. A magnetic separator and roasting plant owned by affiliated interests was under construction at Day's Siding. This plant is to be used not only to treat the low-grade concentrates from the Northwestern Zinc Co.'s mines, but also to treat purchased concentrates.

The 50-ton concentrator of the Hoosier Development Co. was in operation for only three months during 1910. The shaft at this mine is 130 feet deep. The Ten Strike Consolidated Mining Co. sold some lead ore taken out in course of developing the Lucky Strike and the Merry Widow mines. The 25-ton mill on the Ten Strike did not produce any zinc concentrates. The shaft of the Lucky Strike is down 143 feet, and that of the Merry Widow 71 feet. A mill is to be erected at the Merry Widow to treat the zinc and lead ores now on the dump.

The Weinschenk mine was being developed through three shafts 102 feet, 70 feet, and 62 feet deep, respectively, and some lead ore was sold. The Lockie Mining Co. engaged in shaft sinking and shipped no concentrates. The Federal, Marsden-Black Jack, Appleton-Galena, Drill Hole, and Pacific mines were idle all the year.

SOUTHERN ILLINOIS.

The lead and zinc deposits of southern Illinois are found in Pope and Hardin counties in rocks of lower Carboniferous age, and are the northern extension of the Kentucky-Illinois fluorspar district. The structural relations and the mineralogical association are similar to the deposits of western Kentucky and in striking contrast to those of northern Illinois. The ores occur in fissure veins, in association with jointing and faulting. The mines have been worked to depths of 300 and 500 feet without disclosing any decrease in the dimensions of the ore bodies. Dikes and sheets of lamprophyre and dikes of mica peridotite occur in the vicinity, but not in direct connection with the ore deposits. Galena is the most important metallic mineral. Formerly, and nearer the surface, large bodies of galena were worked, but it is at present produced incidentally in the concentration of the fluorspar. For this reason it would be misleading to give crude-ore tonnage. As the district is not reached by railway, the product of the mines is dependent on river transportation.

The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, the silver content ranging up to 12 and 14 fine ounces per ton of lead concentrates, and averaging for the last three years from 4 to 6 fine ounces per ton of lead concentrates. The average silver content recovered from lead concentrates in 1910 was 5.08 ounces and the total quantity recovered 2,022 ounces. Sphalerite or zinc blende is the next important metallic mineral, but it occurs much less plentifully than galena. It is recovered as zinc middlings in the concentration of the fluorspar. The difficulty of making a clean separation of the zinc middlings has kept down the production of zinc. None has been sold from southern Illinois in the last three years. The principal vein minerals are fluorspar, calcite, and barite.

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The mines in the southern Illinois district were in most cases not active in 1910. The Cave-in-Rock Mining Co. and other companies reported some fluorspar sold, but no lead concentrates shipped. The largest shippers of lead concentrates were the Fairview and the Rosiclare mines.

The Fairview Fluorspar & Lead Co. operates on the Good Hope vein, which was first opened up in 1862. The workings are operated by means of 4 shafts and the ore was mined from levels at depths of 100 feet, 150 feet, 235 feet, and 475 feet. The concentrating plant (which has a capacity of 200 tons per 10 hours) and other equipment was overhauled and new boilers and other machinery added in 1910.

The Rosiclare Lead & Fluorspar Co. operates on an ore body which is probably continuous with that of the Fairview. The workings have reached a depth of 300 feet, and the mine has a long record of continuous production. A new steel and concrete mill, entirely fireproof, has been built at Rosiclare, designed to handle 500 tons per day and provided with special facilities for saving the lead and zinc.

IOWA.

By J. P. Dunlop.

PRODUCTION.

The production of lead and zinc in Iowa in 1910 is shown in the following table:

Production of lead and zinc in Iowa in 1910, in short tons.[a]

District.	Ore.						Metal content.			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
	Galena.		Sphalerite.		Carbonate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Dubuque:										
1910	25	$1,320	245	$5,740	.....	.....	20	$1,760	96	$10,368
1909	45	2,079	.....	.....	100	$1,500	36	3,096	35	3,780
1908	63	3,613	829	23,183	.....	.....	51	4,284	395	37,130

[a] In calculating the metal content of the ore from assays, allowance has been made for smelting losses in the case of zinc but not in the case of lead. In comparing the value of ore and metal content it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York and St. Louis.

Tenor of lead and zinc concentrates produced in Iowa, 1909–10.

	1909	1910
Average lead content of lead concentrates.....per cent..	80.0	80.0
Average zinc content of sphalerite concentrates.....do....	.....	.....
Average zinc content of zinc carbonate concentrates.....do....	40.0	.....
Average value per ton of lead concentrates	$46.20	$52.80
Average value per ton of sphalerite concentrates	.....	$23.43
Average value per ton of zinc carbonate concentrates	$15.00	.....

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It is not deemed advisable to publish figures of the total crude-ore production of Iowa in either 1909 or 1910. The production of sphalerite concentrates in 1910 was practically all from the Avenue Top mine. The output of other concentrates for both years was made up of small lots obtained as the result of development work and these are not a fair clue to the average ore tenor. As noted below, the ores occur under much the same condition as in Wisconsin, and the averages reached for that State would hold reasonably well for Iowa.

The lead and zinc deposits of Iowa extend along Mississippi River for nearly 80 miles in Dubuque, Clayton, and Allamakee counties. They are found in the Galena dolomite, of Ordovician age. In early days the Dubuque mines were the most important source of lead in the United States, and in later years the mines, especially those in the vicinity of Durango, yielded considerable quantities of zinc carbonate ore. Nearly all this earlier mining was done above water level, and only within the last few years has there been much attempt to mine below water level. Therefore the production, particularly of zinc ore, for these years, though small, is noteworthy, since it marks the transition from shallow to deeper mining.

The ore deposits of the Dubuque district occur in crevices and in caves or "openings" along these crevices. Of these openings there are five or six, the "top," "middle," and "third" being the most prolific of ore. The "flats" and "pitches" common in the Wisconsin mines have been found in only one or two instances in Iowa. The crevices have an east-west trend, and sometimes extend considerable distances, being mined at different places, in which case they are known as "ranges." The mining operations of recent years have generally been confined to attempts to find paying ore at deeper levels in these old ranges which are known to have yielded ore in former days in the upper openings.

Low ore prices and lack of capital for development work caused a very dull year in the Dubuque mining district. Some mines or prospects, including the Bellman, Grand View, Dubuque Monument, and Riley and Roesner, produced small quantities of lead concentrates, which were sold. Samuel Stromme also produced some lead ore from shallow diggings near Elkader. Most of the mines near Dubuque were idle the entire year pending the starting of the pumps in the old Avenue Top mine, which will lower the water level in adjacent mines. The Aguanico (formerly the Avenue Top) in the western part of Dubuque was actively developed, and it was the only large producer of zinc concentrates in 1910. This company substituted electric power for steam and added Overstrom concentrating tables to their Joplin-type concentrating mill of 100 tons capacity and installed electric hoist and pumps in the mine. All the ore mined in 1910 came from between the 185-foot and the 225-foot levels, but the company was sinking a new 3-compartment shaft to oil rock, or about 325 feet. The adjoining property of Herbst & Hird was purchased during the year.

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KANSAS.

By J. P. Dunlop.

PRODUCTION.

The production of lead and zinc in Kansas in 1910 is shown in the following table:

Production of lead and zinc in Kansas in 1910, by districts, in short tons.[a]

District.	Ores.								Metal content.			
	Lead concentrates.				Zinc concentrates.				Lead.		Zinc.	
	Galena.		Carbonate.		Sphalerite.		Carbonate and silicate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Galena	2,447	$115,022	61	$2,496	20,848	$738,561	106	$1,452	1,991	$175,208	9,977	$1,077,516
Badger-Peacock	526	29,262	....	.....	6,286	259,658	....	.....	421	37,048	3,252	351,216
State, total:												
1910	2,973	144,284	61	2,496	27,134	998,219	106	1,452	2,412	212,256	13,229	1,428,732
1909	1,680	81,728	....	.....	22,840	884,283	503	8,215	1,300	111,800	11,445	1,236,060
1908	3,205	170,227	....	.....	28,524	932,646	395	4,414	2,518	211,512	14,119	1,327,186

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York and St. Louis.

Tenor of lead and zinc ore and concentrates produced in Kansas, 1909–10.

		1909	1910
Total crude ore	short tons	595,786	704,046
Total concentrates in crude ore	per cent	4.2	4.3
Lead	do	.3	.4
Zinc	do	3.9	3.9
Metal content of crude ore	do	2.4	2.5
Lead	do	.2	.3
Zinc	do	2.2	2.2
Average lead content of lead concentrate	do	77.4	79.8
Average lead content of lead carbonate concentrates	do	.....	62.3
Average zinc content of sphalerite concentrates	do	56.1	55.3
Average zinc content of zinc silicate and carbonate	do	38.0	34.0
Average value per ton of lead concentrates (galena)		$48.65	$48.53
Average value per ton of lead carbonate concentrates		.....	$40.92
Average value per ton of sphalerite concentrates		$38.72	$36.79
Average value per ton of zinc silicate and carbonate		$16.33	$13.70

The lead and zinc deposits of Kansas, so far as developed, are limited to the southeastern portion of the State, in Cherokee County. They comprise the western extension of the ore deposits of the Joplin region and display the general characteristics of that area, except that here typical sheet ground deposits have not been extensively developed. The ores are galena and lead carbonate, sphalerite or zinc blende, and zinc carbonate and silicate. The galena is practically nonargentiferous, carrying but a small fraction of an ounce of silver to the ton of lead concentrates.

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Both the lead and the zinc production showed increases in 1910 over those of 1909, but were less than those for the year 1908 and very much less than they were in 1907.

The quantity of lead concentrates shipped was 1,354 tons greater than in 1909 and, although the average selling price was slightly less, the value increased $65,052. The quantity of zinc concentrates sold in 1910 increased 3,897 tons and their value was $104,173 greater. The increased shipment of zinc concentrates was due entirely to operations in the Galena district, as the Badger-Peacock district sales were much less than in 1910, and the Playter district reported no production. Part of the increased lead concentrates sold was derived from the marketing of a large quantity of concentrates recovered in 1909 from ore mined in the Peacock-Galena district.

The increased output for the State is attributable in a large measure to the draining and opening up of old ground in Short Creek bottom. New mills operated by lessees on the Hoosier, Windsor, Murphy, and Galena Lead & Zinc Co. properties turned in large quantities of both lead and zinc concentrates. There were many small operators at work either on old dump piles or small patches of new ground, most of whom sold the dirt or had it treated in custom mills. Production from these sources is, however, growing less, and more attention was given to reaching ore at lower levels on old properties.

The Clermont Land Mining & Milling Co. developed ore in sheet formation at 185 feet in virgin territory 2 miles south of Shoal Creek and completed a 150-ton mill. They were large shippers of high-grade concentrates in 1910. Drill holes put down during the year disclosed rich ore between 225 feet and 280 feet. The Playter interests, including the Peacock-Galena Mining Co. and the Galena Open Cut Mining Co., were being developed and will contribute largely to the 1911 shipments.

Badger-Peacock district.—The bulk of the 1910 production of zinc concentrates was mined and shipped by the S. H. & S. Mining Co. and the Peacock Valley Mining Co., operating on the United Zinc Co.'s fee. There are 6 shafts on the property and 2 concentrating plants of 150 tons and 200 tons, respectively. The Thomas D. Mining Co., a sublessee of the United Zinc Co., on the Roush land, mined some ore from the 80-foot level which was treated in their 150-ton mill.

The only active lessee on the Middlesex Land & Mining Co.'s land was the Badger Mining & Milling Co., which made the second largest "turn-in" (that is, ore sold and delivered) for the district. The Martin land was not worked by the Kramer-Thomas-Reppey Co., and only concentrates produced in 1909 were shipped.

Lawton district.—In the latter part of 1910 the Lawton district, which was developed to a small extent in 1907 and then remained dormant for two years, once more became an active camp. The district is situated 3½ miles north of Badger-Peacock and 14 miles northwest of Joplin, Mo. After prospecting with churn drills the Eastern Lead & Zinc Co. sunk a shaft into ore at 100 feet, and erected a 300-ton electrically equipped concentrating plant. Other prospects are being opened and the new districts will ship concentrates early in 1911.

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Galena district.—The Galena district not only showed a good increase in production over that of 1909, but the new work undertaken promises to extend the increase into succeeding years. Much of the work was on old producing territory in the heart of the district. New mills were built and pumps of large capacity were installed, so that the lower runs of ore could be reached. A large part of the ore mined in this district has been from workings less than 80 feet deep. The results of the extensive drilling during 1910 disclosed the fact that there were ore bodies over a wide area at greater depth which could be profitably treated.

The Diplomat Mining Co. on the Galena Lead & Zinc Co.'s land produced a large quantity of both lead and zinc concentrates during the last five months of the year. Both the mine and the mill, of 150-ton capacity per 12 hours, are equipped with electric power. The mine is opened by 2 shafts to the 100-foot level and the ground is hard, requiring no timber.

The Tiawagh Lead & Zinc Co. erected a concentrating plant on the Battlefield tract, but shipped very little ore during the year. The Lockport Mining Co. operating on the Hoosier, Windsor, Empire, and other lands, was one of the largest producers in the district. The capacity of the concentrators in operation on their leases, including the new 100-ton mill erected by the Mess Mining Co. in 1910, was 250 tons.

Another new producer in 1910 was the Quabradilla Mining Co., a lessee on the Glick Land & Mining Co.'s property west of the old cemetery. A new operator that did not reach the producing stage in 1910 was the Peacock-Galena Mining Co., on the 18-acre tract of the Illinois Zinc Co. north of the old cemetery. The ground was thoroughly prospected, a shaft sunk, and a mill erected which will be a producer early in 1911.

The Southside Mining Co. lessees produced a large output of both zinc and lead concentrates. There were about 50 shafts in operation, ranging in depth from 60 to 110 feet. The most prominent lessees on this property were the Goodeye Mining Co. and the Chase Mining Co. The Latawanna Mining Co. and its lessees, including the Sunshine Mining Co., were large producers of zinc concentrates.

The largest producer on the Murphy land was the Elenita Zinc Co., which operated a 150-ton concentrator. Other lessees on this land were the West Empire Mining Co., E. H. Strauss, Parker & Co., and The Rose Ann Mining Co. Companies reporting a good output in 1910 were the Illinois Lead & Zinc Co., Mokas Mining Co., Ohio Mining Co., The Boston Land & Mining Co., Connor Realty Co., Schmidt Bros., Hartford Mining Co., Nymo Mining Co., New Century Lead & Zinc Mining Co., Gerster & Co., and Wyandotte Lead & Zinc Mining Co. The tailing, sludge, and custom mills having a large output were those of Cook & Kirsch, Friel & Phillips, Keys & Co., G. C. Monlux, and C. W. Squires.

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KENTUCKY.

By J. P. DUNLOP.

PRODUCTION.

Lead and zinc deposits are found in both central and western Kentucky. None of the mines in Franklin, Mercer, Scott, Owen, or Henry counties in the central district reported any lead or zinc concentrates shipped in 1910. The mines in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingstone counties and form a continuation of the southern Illinois lead and zinc region. From four mines in western Kentucky were shipped 56 tons of galena concentrates and 30 tons of zinc carbonate concentrates in 1910. The zinc was derived from surface workings and the lead was separated from fluorspar mined principally in Crittenden County. The lead shipped does not necessarily represent all that was derived from the fluorspar mined, for, being merely accessory to the fluorspar and produced in small quantities, it is frequently held until lead prices are high. Considerable quantities of lead ores have been produced in former years, but at the present time it is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, the silver content varying from a very small quantity to over 3 ounces per ton. From the 56 tons of concentrates shipped in 1910 there were recovered 84 fine ounces of silver, an average of 1.7 ounces to the ton of lead concentrate.

The Kentucky & Indiana Mining Co., operating at Fredonia, 9 miles southwest of Marion, made a production of fluorspar containing some lead, which was sold in 1910.

The American Fluorspar Co., of Crittenden County, mined a small quantity of fluorspar, which contained less than 1 per cent of lead and only a trace of silver. The company had one 200-foot shaft in operation and was sinking a new shaft.

The Eclipse Mining Co. was the largest shipper of lead concentrates in Kentucky in 1910. It has a concentrating plant of 40-ton daily capacity and is sending up ore from the 100-foot level.

The Franklin Mining Co. reports that no lead ore was shipped in 1910. The company was engaged in sinking a 154-foot double-compartment shaft to open a 9-foot vein of fluorspar. The Roberts Fluorspar Co. was developing the Keystone land. It had three shafts 210 feet, 235 feet, and 248 feet deep, respectively, and was engaged in sinking to the 300-foot level and in installing new mine and mill eqipment.

The Hoosier Mining Co. purchased the Tabb mine west of Mexico and operated through 4 shafts, also equipping the property with hoists, pumps, air compressor, and drills.

MICHIGAN.

By B. S. BUTLER.

PRODUCTION.

In 1910 the mines of Michigan produced 222,683,461 pounds of copper, valued at $28,280,800, and 330,500 fine ounces of silver, valued at $178,470, a total value in copper and silver of $28,459,270. This is a decrease of $2,127,423 in value, or nearly 7 per cent, from

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the production of 1909. The decrease in the value of the mineral output was due to a marked decrease in the production of copper and also to a slight falling off in the price of that metal. There was a slight increase in both the quantity and the value of the silver production. For 1909 the average price of copper per pound was $0.13 and for 1910 it was $0.127; the average price of silver for 1909 was $0.52 per fine ounce and for 1910 it was $0.54. Owing to the slight decrease in the price of copper there was a decline from $2.66 in 1909 to $2.54 in 1910 in the average value per ton of rock treated.

The following table shows the average values in copper and silver of rock treated in 1909 and 1910:

Value of silver and copper product of Michigan mines in 1909 and 1910.

Year.	Silver.	Copper.		Combined silver and copper, total value.
		Value.	Value per ton of rock.	
1909	$148,944	$30,437,749	$2.66	$30,586,693
1910	178,470	28,280,800	2.54	28,459,270
Increase (+) or decrease (−)	+ 29,526	− 2,156,949	− .12	− 2,127,423

The entire Michigan output of copper and silver is from the Keweenaw district. Both metals occur native in lodes remarkable for their great extent and uniformity. These lodes may be divided into two general classes: The amygdaloid, in which the metals occur in the cellular portions of lava flows, and the conglomerate, in which the metals cement and to some extent replace the pebbles forming the conglomerate. Native copper and copper minerals occur in fissures in the district, but at the present time the output from this type of deposit is of little importance. The "rock"[1] is of low grade and requires milling, which produces "mineral" carrying an average of about 62 per cent copper. A small quantity of "barrel" and "mass" copper is sorted at the mines and sent direct to the smelters.

In 1910 there were 10,869,561 short tons of rock milled, which yielded 360,840,547 pounds of "mineral" and 222,683,461 pounds of copper.[2]

The recovery of refined copper per ton of rock milled in 1910 was 20.5 pounds, the same as that for 1909.

There were 330,500 ounces of silver derived from the electrolytic treatment of 34,189,526 pounds of copper. This electrolytic copper was recovered from approximately 1,518,000 tons of rock, an average of 0.2176 fine ounce of silver per ton of rock.

[1] Some of the terms used to designate the different materials entering into the mining industry differ for the Lake district from those employed in any other part of the country; ore is known as "rock" or "copper ground" (if unmined); the product of concentration is known as "mineral;" the term "ore" is used to designate the copper minerals (arsenides, sulphides, etc.) that occur to a limited extent in the district. Large bodies of native copper are known as "mass" and smaller ones are designated as "barrel work."

In this report the local terms will be used, as it does not seem desirable to employ the more usual terms to the exclusion of the local, while a mixture of the two is confusing.

[2] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during 1908.

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The following table shows the production of metal, "mineral," and "rock" in Michigan for 1909 and 1910:

Production of silver, copper, "mineral," and "rock" in Michigan in 1909 and 1910.

Year.	Silver.	Copper.			"Mineral."		"Rock."
		Quantity.	Yield per ton of rock.		Quantity.	Yield.	
	Fine ozs.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*	*Short tons.*
1909	286,430	234,136,529	20.5	1.025	358,862,935	65.24	11,429,394
1910	330,500	222,683,461	20.5	1.025	360,840,547	61.71	10,869,561
Increase (+) or decrease (−)	+ 44,070	− 11,453,068			+ 1,977,612	− 3.53	− 559,833

The following table shows the relative importance of the amygdaloid and the conglomerate rock in 1909 and 1910. As in previous years, the most significant fact brought out is the continued decrease in the copper derived from conglomerate and in copper content of the conglomerate. The relative proportion of conglomerate "rock" milled as compared with amygdaloid "rock" showed a slight decrease in 1910 from 1909. The copper derived from conglomerate dropped from 34.7 per cent in 1909 to 31.4 per cent in 1910, and the yield per ton of "rock" from 28.7 pounds in 1909 to 28.3 pounds in 1910.

In 1907 conglomerate "rock" produced 41.4 per cent of the output, with a yield of 33.9 pounds per ton.

In 1910 amygdaloid "rock" yielded 18.2 pounds of copper per ton as compared with 17.7 pounds per ton in 1909.

Production of "rock" and "mineral" and yield in silver and copper in Michigan, in 1909 and 1910, by kinds of rock.

	1909		1910	
	Amygdaloid "rock."	Conglomerate "rock."	Amygdaloid "rock."	Conglomerate "rock."
Silver:				
Fine ounces	286,430		330,500	
Per cent of total				
Average yield per short ton of rock..ounce..	0.025		0.03	
Copper:				
Pounds	153,081,219	81,055,310	152,647,364	70,036,097
Per cent of total	65.3	34.7	68.6	31.4
Average yield per short ton of rock..pounds..	17.7	28.7	18.2	28.3
Average yield.....per cent..	0.88	1.43	0.91	1.415
"Mineral:"				
Pounds	220,395,596	138,467,339	221,969,487	138,871,060
Per cent of total	61.4	38.6	61.5	38.5
Average yield in copper.....per cent..	69.4	58.5	68.8	50.4
"Rock:"				
Short tons	8,612,259	2,817,135	8,395,205	2,474,356
Per cent of total	75.4	24.6	77.2	22.8

Three counties, Houghton, Keweenaw, and Ontonagon, contributed to the output of copper and silver in 1910. The following table shows the relative importance of these counties in output of copper and silver for 1909 and 1910. It may be noted that the increase in silver is not due to a marked increase in the silver content of the "rock," but

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that more copper was treated electrolytically in 1910 than in 1909. Houghton County shows a slight decrease in the recovery of copper per ton of "rock," due to the continued decrease in the conglomerate rock. The recovery for the entire district, however, remains the same as for 1909.

Production of silver and copper in Michigan for 1909 and 1910, by counties.

1909.

County.	Silver.	Copper.			"Mineral."		"Rock."
		Quantity.	Yield per ton of "rock."		Quantity.	Yield.	
	Fine ozs.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*	*Short tons.*
Houghton	285,066	204,843,885	21.4	1.07	318,119,244	64.4	9,546,301
Keweenaw	.....	24,527,685	16.5	.82	33,512,727	73.2	1,478,113
Ontonagon	1,364	4,764,959	11.7	.58	7,230,964	65.9	404,980
Total	286,430	234,136,529	.....	.....	358,862,935	.....	11,427,394
Average	.....	.....	20.5	1.025	.....	65.24	.....

1910.

Houghton	293,387	191,955,538	21.2	1.06	317,444,169	60.5	9,061,790
Keweenaw	37,113	27,923,424	17.7	.88	39,199,881	71.2	1,580,026
Ontonagon	.....	2,804,499	12.3	.61	4,206,497	66.7	227,745
Total	330,500	222,683,461	.....	.....	360,840,547	.....	10,869,561
Average	.....	.....	20.5	1.025	.....	61.71	.....

REVIEW BY COUNTIES.

In the following reviews of the operations at the individual mines of the district during 1910, the statements concerning the quantity, character, and tenor of "rock" developed, the quantity of rock stamped, the copper recovered per short ton of "rock" stamped, and the cost of production are based on the published reports of the companies. In the few cases in which reports are not published, a general statement of the character of operations is made from the best information available.

HOUGHTON COUNTY.

In 1910 the mines of Houghton County produced 191,955,538 pounds of copper and 293,387 ounces of silver, or 86.2 per cent of the copper and 88.7 per cent of the silver output of Michigan. The county occupies the central portion of the copper belt and contains 15 of the 23 mines that contributed in 1910 to the copper output and 6 of the 8 mines that produced silver.

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The details of the production in 1909 and 1910 are shown in the following table:

Production of "rock" and "mineral" and average yield in silver and copper in Houghton County in 1909 and 1910, by kinds of rock.

	Amygdaloid rock.		Conglomerate rock.		Total and average.	
	1909	1910	1909	1910	1909	1910
Silver:						
Fine ounces	[a] 285,066	293,387	.....	.....	285,066	293,387
Copper:						
Pounds	123,812,575	121,919,441	81,031,310	70,036,097	204,843,885	191,955,538
Per cent, county total	60.5	63.5	39.5	36.5	100.0	100.0
Average yield per ton of rock in pounds	18.3	18.6	28.7	28.3	21.4	21.2
Average yield...per cent.	0.91	0.93	1.43	1.41	1.07	1.06
"Mineral:"						
Pounds	179,651,905	178,573,109	138,467,339	138,871,060	318,119,244	317,444,169
Average yield...per cent.	68.9	68.2	58.5	50.4	64.4	60.4
"Rock:"						
Short tons	6,729,166	6,587,434	2,817,135	2,474,356	9,546,301	9,061,790
Per cent, county total	70.5	72.7	29.5	27.3	100.0	100.0

[a] Silver from conglomerate and from amygdaloid rock has not been separated. A large percentage, however, was derived from amydaloid rock.

The county shows a decrease of 12,888,347 pounds of copper and an increase of 8,321 fine ounces of silver. This increase in silver, as already stated, is due to an increase in the quantity of copper that was refined electrolytically, rather than to any marked change in silver content of the "rock."

Calumet & Hecla.—The Calumet & Hecla mine has been one of the most successful copper mines in the world. In the yield of copper and dividends paid it ranks first among the copper mines of the country. To the close of 1910, the company had distributed $113,450,000 in dividends.

The company's ground contains three copper-bearing lodes, the "Calumet" conglomerate, the Osceola amygdaloid, and the "Kearsarge" amygdaloid. A large percentage of the production in the past has come from the conglomerate lode, but with the decrease in copper content of this lode and its approaching exhaustion the mining from the amygdaloid lodes has increased.

During 1910 there were 2,795,514 short tons of rock stamped, yielding 72,059,545 pounds of copper, or an average of 25.77 pounds of copper per ton of "rock." This compares with a yield of 28.18 pounds for 1909 and of 31.22 pounds for 1908. The total cost per pound of copper was 8.96 cents for 1910, as compared with 8.28 cents for 1909 and with 9 cents for 1908.

The conglomerate is opened for a distance of nearly 2 miles along its strike by 10 inclined and 1 vertical shaft. The inclined shafts vary in depth in the dip of the lode from 6,000 to 8,000 feet. The Red Jacket vertical shaft has a depth of 4,900 feet. The lode in the "Five Forties" tract, extending north from the company's main holdings, is developed by a slope shaft from the fifty-seventh level. The rock from this shaft is hoisted to the surface through the Red Jacket shaft.

It is reported that the ground opened by Hecla Nos. 6 and 7 during the year showed improvement, and the same was true of the devel-

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opment on the south side of Hecla Nos. 9 and 10. The development in the Calumet end of the lode showed ground of average quality.

The conglomerate lode produced 1,950,040 tons of "rock," yielding 58,739,509 pounds of copper, or an average of 30.12 pounds per ton of rock. This compares with 33.14 pounds for 1909, and with 35.96 pounds for 1908.

The cost of producing copper from the conglomerate lode in 1910 was 8.55 cents per pound, as compared with 7.77 cents in 1909 and with 8.38 cents in 1908.

The Osceola lode is developed by 6 shafts varying in depth from 1,234 to 3,232 feet. The lode has an average width of from 30 to 35 feet, though at some points it is much wider. The mineralization is confined principally to the hanging and the foot walls. The lode is opened by drift stopes along the hanging wall, where the mineralization is rather uniform. Crosscuts are extended to the footwall, where the mineralization is far less regular. During 1910 this lode produced 831,194 tons of "rock," yielding 13,150,427 pounds of copper, or 15.82 pounds per ton of "rock." This compares with a yield of 16.40 pounds for 1909 and of 17.67 pounds for 1908. The average cost per pound of copper from this lode for 1910 was 10.53 cents, as compared with 10.41 cents for 1909 and with 12.25 cents for 1908.

The Kearsarge lode is opened by 3 shafts, varying in depth from 1,350 to 2,164 feet. Development on this lode in Calumet and Hecla ground has not been encouraging, though the lode has proved very productive farther north. During the year 14,280 tons of "rock" from this lode yielded 169,609 pounds of copper.

The recrushing plant treating coarse conglomerate tailings from the Calumet mill produced 1,951,378 pounds of copper, at a cost of 5.08 cents per pound, exclusive of smelting and selling. The company now has under consideration the construction of a second recrushing plant, in which conical pebble mills will replace the Chili mills used in the present plant. Experiment has shown the pebble mill to be the more efficient and the construction will also be cheaper. A part of the capacity of these mills will be employed in re-treating the conglomerate sands in Torch Lake.

Tamarack.—The Tamarack ground lies northwest of the Calumet and Hecla, and its operations are conducted on the underlays of the "Calumet" conglomerate and the Osceola amygdaloid. Both lodes enter the property at considerable depth and are reached by vertical shafts, the different levels being connected with these shafts by crosscuts. The property is opened by 5 shafts, varying in depth from 3,409 feet (No. 1) to 5,281 feet (No. 5), the latter having the distinction of being the deepest shaft in the world.

The company, although at a disadvantage on account of the great depth of the mine, and the consequent high mining costs, has made a good record in dividends, which from 1888 to 1907 aggregated $9,420,000. Since the decline in the price of copper in 1907, however, the company has been unable to show a profit and the cost of production must be materially reduced before dividends can be earned at the prevailing price of copper for the last three years.

The average cost per pound of production during the last three years has been 15.24 cents for 1908, 14.30 cents for 1909, and 14.70 cents for 1910, resulting in a net loss for each year.

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Shaft No. 1 is used for handling the water in the southern portion of the mine, thus leaving the neighboring shafts free for the hoisting of ore. During the year approximately 29,000,000 gallons of water per month were raised through this shaft.

At the No. 2 shaft stoping was carried on in the conglomerate lode between the twenty-sixth and the thirtieth levels.

At No. 3 shaft the incline that follows the lode from the eighteenth level was completed to the twenty-first level. A compressed-air engine was installed, which hoists rock to the eighteenth level. Development work in this shaft for the year showed good values.

No. 5 shaft is bottomed at the forty-first level in the Osceola amygdaloid, which shows poor copper values at that point. The drift south on the thirty-ninth level was in poor ground during the earlier part of the year, but showed some improvement as it was advanced to the south, and at the close of the year was in ground of average quality.

During the year 525,554 tons of "rock" were stamped, yielding 22,053,480 pounds of "mineral" or 11,063,606 pounds of copper, or 21.1 pounds refined copper per ton of "rock" stamped. This compares with a yield of 19.6 pounds for 1908 and 1909.

Osceola.—The Osceola Co. operated the three branches, the Osceola, the South Kearsarge, and the North Kearsarge.

Owing to the lower price of copper and the comparatively high cost of production, the Osceola branch was closed down on March 1, 1910. The other branches were operated throughout the year.

The Osceola lies directly south of the Calumet & Hecla, and is worked on the Osceola amygdaloid. The property contains the Calumet & Hecla lode, but the only portion of this in Osceola ground that has been shown to carry copper in paying quantities was worked out in the early days of the mine. The reserves of copper-bearing ground are large, but the cost of production is higher than for either of the other branches, little if any profit being possible at the present price of copper.

The North Kearsarge lies north of the Wolverine and is worked on the Kearsarge lode. No. 1 shaft has a depth of 3,873 feet, No. 2 shaft has a depth of 3,192 feet, and No. 3 shaft has a depth of 1,143 feet. A total of 7,326 feet of opening was accomplished on this branch during the year. There was a considerable increase in production from this branch during the year but the grade of the "rock" developed has shown a falling off. The average copper saved from this branch during the year was 14.47 pounds per ton.

The South Kearsarge lies south of the Wolverine and east of the Centennial on the Kearsarge lode. No. 1 shaft has a depth of 2,820 feet and No. 2 shaft has a depth of 1,992 feet. During the year a total of 1,440 feet of opening was accomplished. The ground in this branch is practically developed and at the present rate of production will be worked out in four or five years.

The cost of production from this branch is the lowest of the three, the profits from the branch for the year being $430,000. During the year a portion of the mill was remodeled for a more efficient treatment of the rock from the Kearsarge lode.

In 1910 the company stamped 1,217,720 tons of "rock," producing 25,669,913 pounds of "mineral," or 19,346,566 pounds of copper, an average yield of 15.9 pounds of refined copper per ton of "rock."

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This compares with a yield of 16.9 pounds per ton for 1909 and of 17.1 pounds per ton for 1908. The total cost of refined copper per pound was 9.37 cents for 1910 as compared with 9.47 cents for 1909 and with 10.25 cents for 1908.

Centennial.—The Centennial ground lies north of the Calumet & Hecla and west of the South Kearsarge and the Wolverine. It contains the Calumet and Hecla, the Osceola, and the Kearsarge lodes, the last being the only one of proved value in the property, and to this lode operations are at present confined.

At the close of the year the depth of No. 1 shaft was 3,821 feet. A total of 211 feet of opening was accomplished at this shaft before it was closed down on June 1. Shaft No. 2 had a depth of 3,955 feet at the close of the year. A total of 2,641 feet of development was accomplished at this shaft. Some fair ground was opened on the thirtieth, the thirty-first, and the thirty-third levels north of No. 2 shaft.

"Rock" to the amount of 102,133 tons was stamped during the year, producing 2,380,820 pounds of "mineral" and 1,572,566 pounds of refined copper. The average cost of refined copper per pound was 14.48 cents.

Three new compound heads were added to the mill during the year by the Lake Milling, Smelting & Refining Co.

Wolverine.—The Wolverine is located between the North and the South Kearsarge branches of the Osceola Co. Its operations are on the "Kearsarge" amygdaloid, though the West lode, parallel with the Kearsarge lode and about 80 feet to the west, has been opened to a small extent. The mine has the distinction of having the richest amygdaloid, and next to the "Calumet" conglomerate, the richest rock mined in the district. The lode is opened by 4 shafts, numbered from 1 to 4 from north to south. No. 1 is abandoned; No. 2, bottomed at the boundary at a depth of 1,700 feet, is used for handling men and supplies; No. 3 is below the twenty-fifth level and can be sunk to a depth of 4,300 feet before reaching the boundary; No. 4 was sunk below the thirty-third level during the year. The lode in the Wolverine ground shows great uniformity of mineralization and is opened for the full length. In the upper levels the rock averaged from 16 to 18 pounds per ton, but as the lower levels were opened it showed marked improvement, the average for the fiscal year ending June 30, 1911, being 24.75 pounds per ton. The mine has ore blocked out well ahead of stoping requirements and at the present rate an assured output for some years to come. A crosscut has been extended east on the twenty-eighth level to explore the footwall of the Kearsarge lode, but at a distance of 400 feet had cut nothing worthy of examination.

During the fiscal year ending June 30, 1911, the mill at Traverse Bay stamped 388,476 tons of rock, yielding 12,227,500 pounds of "mineral," or 9,617,168 pounds of fine copper, or 24.75 pounds of fine copper per ton of "rock" stamped. The average cost of copper for this period was 7.54 cents per pound, lower than for any other copper mine in the district.

Franklin.—The Franklin and the Rhode Island, which is controlled by the Franklin, are located southeast of the La Salle. The property carries several lodes, but in the past exploration has been principally on the "Pewabic" amygdaloid and the Allouez or

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"Albany and Boston" conglomerate. During 1910 operations were confined to the Pewabic lode.

The principal operations for the year were below the twentieth level. A total of 2,772 feet of drifting was accomplished on levels twenty-six to thirty-one, all in good stoping ground.

Two heads at the mill were run day shifts for the year, stamping 113,859 tons of "rock."

Quincy.—The Quincy mine is situated just north of the east-west arm of Portage Lake. The property is traversed by most of the lodes of the district, but has derived its principal output in the past from the Pewabic lode with a small quantity from the West lode. During 1910 the company acquired 800 acres of land adjoining the property on the northwest and carrying the extension of the Pewabic lode.

During 1910 the company paid dividends amounting to $495,000, making a total of $19,440,000 since the payment of dividends began in 1862. The production of 22,517,014 pounds of copper in 1910 was the largest in the history of the mine.

Development work was slightly greater than in 1909 and opened copper ground of about the usual grade.

At the smelter a new reverberatory furnace was nearly completed.

During the year 1,373,124 tons of "rock" were hoisted, yielding 34,177,380 pounds of "mineral" or 22,517,014 pounds of refined copper. Mass copper constituted 21 per cent of the "mineral" produced.

Isle Royale.—The Isle Royale mine is situated south of the east-west arm of Portage Lake, near Houghton. The property contains several copper-bearing lodes, of which the Isle Royale is the main producer at present. Development during the year consisted of 511 feet of sinking and 14,588 feet of drifting, drift stoping and crosscutting. The Isle Royale lode is opened by four shafts, having depths at the close of the year as follows: No. 2, 3,102 feet; No. 4, 994 feet; No. 5, 803 feet; No. 6, 1,028 feet. At No. 2 shaft 5,489 feet of drifting and drift stoping developed ground slightly below the average. At No. 4 shaft 2,421 feet of drifting and drift stoping developed ground of about the average grade. At No. 5 shaft 2,331 feet of opening showed ground of average grade. At No. 6 shaft 2,936 feet of opening developed ground of average grade. At the "A" shaft, on the south side of the Hussey-Howe tract, 1,283 feet of drifting and crosscutting produced no very encouraging results.

During the year 520,860 tons of "rock" were stamped, producing 10,433,060 pounds of "mineral," yielding 7,567,399 pounds of copper, or 14.5 pounds of refined copper per ton of "rock" stamped. The total cost per pound of refined copper was 11.84 cents. In 1909 a total of 401,280 tons of "rock" stamped produced 7,926,015 pounds of "mineral" or 5,719,056 pounds of copper, at a cost of 16.64 cents per pound.

Baltic, Champion, and Trimountain.—These three mines are located on the Baltic lode southwest of Houghton and are under the same management, that of the Copper Range Consolidated Co. The Baltic is an exceptionally strong lode, having a stoping width varying from 15 to 80 feet. The lode has produced considerable "mass" copper and also contains veinlets of copper minerals, includ-

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ing chalcocite, bornite, and copper arsenides. These minerals are recovered in the mill, and the arsenides probably account in part for the arsenical character of the copper range output.

During 1910 the Baltic operated 4 shafts, varying in depth from 1,624 to 2,164 feet at the close of the year. A total of 11,218 feet of drifting and 465 feet of crosscutting was accomplished during 1910. The new ground opened under No. 3 shaft and south of it was not as good as usual, while that opened under and north of No. 4 shaft was better than usual. A total of 781,419 tons of "rock" was stamped, producing 28,067,300 pounds of "mineral," yielding 17,549,762 pounds of refined copper or 22.46 pounds of refined copper per ton of "rock" stamped. The cost per pound of refined copper was 8.32 cents.

The Trimountain is also opened by 4 shafts, with depths varying from 1,806 to 2,453 at the close of the year. A total of 8,728 feet of drifting and 752 feet of crosscutting was accomplished. The main production for the year was from No. 4 shaft. Drifting on the twenty-second level of No. 1 shaft disclosed a strong lode well charged with copper. The upper part of this shaft has been worked out and it was abandoned. The ground in the lower levels will be mined through No. 2 shaft.

The openings in the lower levels of No. 2 and No. 3 shafts showed improvement over previous years.

A total of 317,299 tons of "rock" was stamped, producing 9,598,900 pounds of "mineral," or 5,694,868 pounds of refined copper, a yield of 17.95 pounds of refined copper per ton of "rock" stamped. The cost per pound of copper was 12.17 cents. The company showed a profit of $32,250 for the year as compared with a deficit of $47,841 for 1909.

The Champion, controlled jointly by the Copper Range Consolidated Co. and the St. Mary's Mineral Land Co., like the two mines just described, is opened by 4 shafts, with depths varying from 1,951 to 2,108 feet at the close of the year. A total of 12,262 feet of drifting and 1,145 feet of crosscutting was accomplished.

A total of 722,051 tons of "rock" was stamped, yielding 30,508,690 pounds of "mineral," or 19,224,174 pounds of refined copper, a yield of 26.62 pounds per ton of "rock" stamped. The cost of refined copper per pound was 7.85 cents.

Superior.—The Superior is located northeast of the Baltic on the Baltic lode. The lode on this property is being opened by 2 shafts. At the close of the year No. 1 shaft had reached a depth of 1,514 feet, and No. 2 a depth of 927 feet. A crosscut was extended from No. 1 shaft to the lode on the sixth level and a drift to the north developed a patch of good ground about 70 feet from the crosscut. During the year 140,514 tons of "rock" were stamped at the Atlantic mill, producing 3,181,041 pounds of copper, or 22.64 pounds per ton of "rock" stamped. The cost of copper per pound was 14.29 cents.

Atlantic.—At the Atlantic mine, exploring work was continued on section 16 and some diamond drilling was done on section 9. The exploration of the year did not result in the development of commercial ground. The shaft on section 16 has a depth of 2,295 feet. During the year 6,778 feet of drifting and crosscutting was accomplished.

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A total of 151¼ tons of "rock" was stamped from section 16, yielding 5,740 pounds of "mineral."

In 1911 this property was consolidated with the Copper Range Consolidated Co.

La Salle.—The La Salle mine, located between the Osceola and the Rhode Island, was developing the Kearsarge lode through 2 shafts at the close of the year. Development in the southern part of the property was discontinued. The only important developments of copper ground were in the most northerly shaft, Tecumsea No. 1.

Shipments of rock to the Allouez-Centennial mill were made during the year.

Hancock.—Development continued at the Hancock mine during the year. At No. 1 shaft the principal development work was confined to No. 3 vein at the twelfth, thirteenth, fourteenth, fifteenth, sixteenth, and eighteenth levels. The total amount of drifting was 3,046 feet.

No. 2 shaft was sunk 598 feet to a depth of 2,668 feet.

Early in 1911 shipments of "rock" were begun to the Allouez-Centennial mill. It is reported that to June 1 the "rock" stamped had yielded an average of 19.27 pounds of copper per ton.

Wyandot.—At the Wyandot, operations were continued in exploratory shaft No. 11, the crosscut to the east being advanced to a distance of 1,689 feet from the shaft. No new copper-bearing lodes were encountered in this work. Diamond drilling on sections 16 and 21 disclosed some promising copper-bearing lodes.

A shaft was started to explore a promising lode encountered by the diamond drill on section 16. This was sunk to a depth of 65 feet, where crosscutting was started to explore the lode. The lode showed a width of 38 feet, about 10 feet in the footwall carrying some fine copper.

Winona.—Development continued at the Winona mine, the No. 4 shaft being sunk to a depth of 1,460 feet. With a few exceptions, the openings below the tenth level were not as good as on the higher levels.

The stamp mill, built jointly with the King Philip, was nearly completed, and one stamp began operations early in 1911. Steps were taken early in 1911 to consolidate the Winona and the King Philip properties.

King Philip.—Development was continued during the year at the 2 shafts of the King Philip mine. Shaft No. 1 was sunk 180 feet and No. 2 was sunk 359 feet. A total of 395 feet of crosscutting, 5,563 feet of drifting, and 294 feet of raising was accomplished. This disclosed ground of about the same average character as in previous years.

It has already been stated that the stamp mill was nearly completed, and that plans were formed to merge the King Philip property with that of the Winona.

Mayflower.—Diamond drill exploration was carried on at the Mayflower through the year. A lode of some promise was encountered in No. 11 drill hole, and this will probably be explored farther.

Oneco.—Diamond drill exploration was conducted at the Oneco property during the year. At the close of the year the 500-foot shaft in the Oneco lode was being unwatered to explore that lode farther.

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New Baltic.—A shaft was started on this property which had reached a depth of about 200 feet at the close of the year.

New Arcadian.—Diamond drill operations were conducted on the New Arcadian property, resulting in the cutting of a lode of some promise, which is being explored farther.

KEWEENAW COUNTY.

In 1910 Keweenaw County produced 27,923,424 pounds of copper and 37,113 fine ounces of silver, being 12.5 per cent of the copper and 11.1 per cent of the silver produced in the Lake district. The county occupies the northern part of the Keweenaw Peninsula and contains the northern portion of the copper belt. This section of the belt produced considerable copper in the early days of Lake mining, but of late years has furnished a comparatively small percentage of the total output. Developments, however, indicate that the county should increase in importance in the future.

The following table shows the production of "rock" and "mineral" and the average yield in silver and copper in Keweenaw County for 1909 and 1910:

Production of "rock" and "mineral" and average yield in silver and copper in Keweenaw County in 1909 and 1910.

Year.	Silver.	Copper.			"Mineral."		"Rock."
		Quantity.	Yield per ton of rock.		Quantity.	Yield.	
	Fine ozs.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*	*Short tons.*
1909		24,527,685	16.5	0.82	33,512,727	73.2	1,478,113
1910	37,113	27,923,424	17.7	.88	39,189,881	71.2	1,580,026

From this table it is seen that in 1910 there was an increase in the quantity of "rock" treated, and also an increase in the quantity of copper recovered per ton of "rock." The marked increase in the recovery of silver over previous years was owing to the fact that considerable copper was refined electrolytically.

Allouez.—The Allouez mine is north of the North Kearsarge and, as in recent years, has confined its operations to the Kearsarge lode. As this lode does not outcrop on Allouez property, the shafts were started in the hanging wall at a steep angle and flattened to the dip of the copper-bearing bed just before reaching it. This plan avoids the expense of long crosscuts necessitated by vertical shafts. At the end of the year No. 1 shaft had a depth of 3,118 feet. A total of 4,391 feet of opening was accomplished at this shaft during the year. No. 2 shaft had a depth of 2,989 feet, and 2,367 feet of opening was accomplished. The openings at No. 1 shaft have been promising, especially to the north. The openings at No. 2 shaft have proved some good ground; the bottom of the shaft at the end of the year looked well.

A total of 247,119 tons of "rock" was stamped during the year, yielding 7,406,970 pounds of "mineral," or 4,655,702 pounds of refined copper, or 18.84 pounds of refined copper per ton of "rock"

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stamped. The average cost per pound of refined copper for the year was 11.57 cents.

Ahmeek.—The Ahmeek mine, lying north and east of the Allouez, is also located on the Kearsarge lode. The lode is opened by 4 shafts. No. 1 has a depth of 2,075 feet. A total of 5,160 feet of drifting was accomplished on this level, developing good copper ground except on the sixth, seventh, and eighth levels south, which were in poor ground.

No. 2 shaft has a depth of 2,207 feet, and 3,688 feet of drifting was accomplished, developing good copper ground. In January, 1911, No. 3 shaft entered the Kearsarge lode at a depth of 1,264 feet and No. 4 shaft at a depth of 1,240 feet.

During the year 530,365 tons of "rock" were stamped, yielding 16,758,521 pounds of "mineral," equivalent to 11,844,954 pounds of refined copper. The total cost of refined copper per pound for the year was 11.05 cents.

Mohawk.—The Mohawk mine, lying east of the Ahmeek, carries the outcrop of the Kearsarge lode for more than a mile, and also contains several cross fissures carrying arsenides of copper, which have been mined to considerable extent in the past. Operations were conducted through 5 shafts. Nos. 1 and 2 are below the nineteenth level, No. 4 is below the sixteenth level, No. 5 is below the eleventh level, and No. 6 is below the seventh level. A total of 13,887 feet of drifting during the year developed ground of about the usual grade. A total of 802,537 tons of "rock" was stamped, yielding 15,013,500 pounds of "mineral," or 11,412,066 pounds of copper, a yield of 14.22 pounds of refined copper per ton of "rock" stamped.

The total cost of refined copper per pound for the year was 11.44 cents.

Arnold.—A small amount of mass copper was produced from the "Arnold" ash bed and shipped to the smelter.

Keweenaw.—The principal operations of the Keweenaw Copper Co. was the sinking of the shaft 518 feet to a depth of 623 feet. It is planned to explore the lode, which is supposed to be the Kearsarge lode at greater depth. A diamond drill core taken from this lode at a depth of 1,350 feet showed good copper values.

Cliff.—At the Cliff property a shaft was started to explore the Kearsarge lode but had not reached a great depth at the close of the year.

Ojibway.—Development was continued at the Ojibway mine and it is reported that good ground was opened. It is expected that this property may begin shipments in 1911.

Seneca.—Development was continued at the Seneca mine during the year, and the Kearsarge lode was explored and some copper ground opened.

Gratiot.—The Gratiot continued the development of the Kearsarge lode. No. 1 shaft was sunk to a depth of 1,901 feet, and 1,042 feet of drifting and 36 feet of crosscutting were accomplished. The openings show no material change in the copper values.

Operations at No. 2 shaft were discontinued July 1, on account of the poor showing of the ground developed.

"Rock" to the amount of 28,522 tons from No. 1 shaft was stamped during the year, yielding 265,869 pounds of copper, or 9.32 pounds per ton of "rock."

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ONTONAGON COUNTY.

In 1910 Ontonagon County produced 2,804,499 pounds, or 1.2 per cent of the copper produced in the Lake district. No silver was reported from the county in 1910. Ontonagon County contains the southwestern portion of the copper belt. This portion has not been so thoroughly developed, and consequently the geology is less understood than in the more northern counties. So far as developed, the lodes are more bunchy than to the north and have produced a relatively high percentage of mass copper. The production of 1910 was derived wholly from amygdaloid rock.

The following table shows the production of the county for 1909 and 1910:

Production of "rock" and "mineral" and average yield in silver and copper of Ontonagon County in 1909 and 1910.

Year.	Silver.	Copper.			"Mineral."		"Rock."
		Quantity.	Yield per ton of "rock."		Quantity.	Yield.	
	Fine ozs.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*	*Short tons.*
1909	1,304	4,764,950	11.7	0.58	7,230,964	65.9	404,980
1910	.....	2,804,499	12.4	.63	4,206,497	66.7	227,745

This shows a marked decrease in the copper produced, owing to the fact that several of the mines of the county were unable to produce at the price prevailing for copper during 1910. The developments in the county for the last few years, however, have been very encouraging, and it will probably show an increase in production in the future.

Adventure.—Operations during the year were confined to the sinking of the shaft to cut the three lodes that were located by diamond drills during 1908 and 1909. At the close of the year the shaft had reached a depth of 1,092 feet. The first of the three lodes was passed through and found to carry good heavy copper on the footwall. No drifting was done on this lode.

Mass.—The Mass mine, adjoining the Adventure on the southwest, carries 6 known copper-bearing amygdaloid lodes, the Knowlton, the Mass, the North Butler, the Butler, the Ogima, and the Evergreen. In addition, the position of the property makes it probable that the newly discovered lodes in this part of the district may be present in the Mass ground. The main developments for the year were from shaft "C" on the Butler lode and the results were very satisfactory.

During the year steps were taken to acquire the property of the Evergreen Bluff Mining Co. This will give the Mass company opportunity for additional development on the Evergreen lode.

During the year, 90,747 tons of "rock" were stamped, yielding 1,790,795 pounds of "mineral," or 1,321,885 pounds of refined copper, a yield of 14.59 pounds of refined copper per ton of "rock" stamped.

Michigan.—The Michigan mine has 3 shafts on the Calico lode, with crosscuts reaching to the Branch lode and to other lodes of less importance. In recent years the production has been largely from the Calico and the Branch lodes, though other lodes have contributed

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in the past. The mine has been a famous producer of "mass" copper, and the Branch lode, though narrow, is one of the richest lodes of the district.

The Calico lode is from 5 to 25 feet wide in the upper workings, but narrows to 4 or 6 feet at the 2,000-foot level. In the upper workings, the copper occurs as a pay streak on the footwall, with patches of good ground on the hanging wall and in the center of the lode.

Operations for the year were confined largely to the Bee property, but were not encouraging and in January, 1911, work was discontinued. Diamond drill exploration was carried on through the year, but this also was discontinued in March, 1911. "Rock" to the amount of 3,000 tons, sent to the Atlantic mill, yielded slightly over 12 pounds of copper per ton.

Victoria.—The Victoria is the most southwesterly of the Lake mines that have made important production. The first attempts at copper mining in the district are said to have been made at this locality, though its recent period of productiveness began in 1906. The present production is from the Forest lode. The old No. 2 shaft through which present operations are carried on is bottomed at the twenty-second level. Operations for the year were conducted on levels between the fourth and the twenty-second levels, a total of 1,344 feet of opening resulting in the development of copper ground of grade better than the average for the mine. The new No. 6 shaft was sunk to a depth of 463 feet, but it will be necessary to sink 187 feet farther to reach the point at which copper was encountered by the diamond drill.

As in previous years operations were hampered by lack of water for power and plans were under consideration at the close of the year for providing additional water supply. During the year, 122,497 tons of "rock" were stamped, producing 1,923,599 pounds of mineral.

Lake.—At the Lake mine, development was continual through the year, the shaft being bottomed at the eighth level, but the crosscut had not reached the lode. At the seventh level the drifting accomplished indicated that the lode carries values at that depth equal to those in the higher levels. A limited amount of "rock" was sent to the mill in the early part of the year, but during the latter part of the year operations have been confined to development.

Early in 1911 it was determined to sink a new shaft in the lode as the cost of crosscutting from the old shaft was becoming excessive.

A limited amount of development on the East lode met with encouraging results.

The results of stamping to July, 1910, when shipments ceased, were as follows: Tons of "rock" stamped, 14,485, yielding 318,050 pounds of copper, or an average of 21.957 pounds per ton of "rock" stamped.

North Lake.—Diamond drilling was continued during the year by the North Lake Mining Co. to gain additional information before locating a shaft.

Indiana.—Diamond drilling was continued on the property during the year with encouraging results, nearly every hole drilled showing copper in more or less encouraging quantities. Late in the year a shaft was started to explore the lode from which the rock core was taken in hole No. 2.

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Algomah.—During the year a shaft was sunk to a depth of 110 feet and at a depth of 104 feet a lode was crosscut and found to have a thickness of about 40 feet. Drifts have been extended north and south a total distance of 1,000 feet, encountering bunches of copper ore. Unlike the other lodes of the district, the copper is in the form of oxides, carbonates, and silicates.

South Lake.—Diamond-drill exploration was carried on at the South Lake in 1910, with encouraging results. No. 3 hole cut four copper-bearing lodes of unusual promise. Later, holes Nos. 4, 5, and 6 cut the same lodes, and No. 7 cut the first two, when it was discontinued.

MISSOURI.

By J. P. Dunlop.

PRODUCTION.

The production of lead and zinc in Missouri in 1910 is shown in the following table:

Production of lead and zinc in Missouri in 1910, by districts, in short tons.[a]

District.	Ore.							
	Lead concentrates.				Zinc concentrates.			
	Galena.		Carbonate.		Sphalerite.		Silicate and carbonate.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Southwest Missouri:								
Alba-Neck City	255	$12,460	1	$18	21,108	$828,352	47	$1,155
Ashgrove-Everton	54	2,731	32	780	.....	.....	400	8,000
Aurora	215	10,377	1	12	4,275	174,787	3,423	76,016
Carl Junction	20	1,008	.....	.....	3,215	128,723	.....	.....
Carthage	57	2,869	.....	.....	5,661	229,552	170	3,434
Cave Springs	56	2,814	.....	.....	1,761	66,019	.....	.....
Duenweg-Porto Rico	3,179	159,781	5	197	19,731	772,145	2,075	49,280
Granby	393	19,341	26	749	5,206	191,739	9,310	240,657
Joplin	6,062	305,209	51	1,643	47,200	1,908,749	1,403	27,672
Oronogo	1,327	71,360	.....	.....	8,382	344,679	.....	.....
Sarcoxie-Reeds	24	1,249	.....	.....	2,427	96,736	2,049	42,715
Sherwood	353	17,548	.....	.....	2,247	98,233	.....	.....
Spring City-Beef Branch	1,241	64,707	41	1,520	2,468	84,441	3,062	73,573
Springfield [b]	38	2,150	.....	.....	131	6,020	170	2,428
Spurgeon	757	37,638	40	1,516	224	7,838	589	13,648
Stotts City	15	759	.....	.....	841	32,484	.....	.....
Webb City, Carterville-Prosperity	22,772	1,206,676	.....	.....	104,788	4,258,887	.....	.....
Wentworth	.....	.....	.....	.....	46	1,848	162	3,866
Zincite	153	7,769	.....	.....	2,630	110,907	17	355
Total	36,971	1,926,441	197	6,385	232,341	9,342,139	22,897	542,803
Central and southeast Missouri	210,890	9,360,309	.....	.....	.....	.....	929	19,000
State, total:								
1910	247,861	11,286,750	197	6,385	232,341	9,342,139	23,826	561,803
1909	249,151	10,893,024	385	11,124	229,023	9,445,826	28,525	677,213
1908	218,213	8,629,039	664	18,220	196,340	6,800,359	20,601	451,607
1907	193,528	10,535,890	357	11,764	222,347	9,208,465	18,733	427,146

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc, but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York and St. Louis.

[b] Includes total production of several mines in Barry, Greene, and Howell counties to avoid disclosure of individual production.

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Production of lead and zinc in Missouri in 1910, by districts, in short tons—Continued.

District.	Metal content.			
	Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.
Southwest Missouri:				
Alba-Neck City	204	$17,952	11,218	$1,211,544
Ash Grove-Everton	62	5,456	127	13,716
Aurora	174	15,312	3,495	377,460
Carl Junction	16	1,408	1,690	182,520
Carthage	44	3,872	3,005	324,540
Cave Springs	45	3,960	885	95,580
Duenweg-Porto Rico	2,530	222,640	10,986	1,186,488
Granby	327	28,776	6,024	650,592
Joplin	4,757	418,616	25,092	2,709,936
Oronogo	1,061	93,368	4,425	477,900
Sarcoxie-Reeds	19	1,672	1,904	205,632
Sherwood	282	24,816	1,214	131,112
Spring City-Beef Branch	1,020	89,760	2,274	245,592
Springfield[a]	31	2,728	133	14,364
Spurgeon	623	54,824	336	36,288
Stotts City	12	1,056	447	48,276
Webb City-Prosperity	18,188	1,600,544	54,511	5,887,188
Wentworth	.....	.....	81	8,748
Zincite	122	10,736	1,399	151,092
Total	29,517	2,597,496	129,246	13,958,568
Central and southeast Missouri	131,499	11,571,912	343	37,044
State, total:				
1910	161,016	14,169,408	129,589	13,995,612
1909	159,435	13,711,410	130,162	14,057,496
1908	144,459	12,134,556	107,404	10,095,976
1907	138,675	14,699,550	116,752	13,776,736

[a] Includes total production of several mines in Barry, Greene, and Howell counties, to avoid disclosure of individual production.

In 1910, as was the case in the years 1907, 1908, and 1909, the entire production of copper in Missouri was that of one shipper. In 1910 the Doe Run Lead Co. reported 94,452 pounds of copper derived from concentrates recovered in treating lead ore from its mine in St. Francois County, in southeast Missouri. These figures are published with the permission of the company. The North American Lead Co., which produced copper in each of the three preceding years, had no production in 1910.

Production of silver in Missouri, 1907–1910.

Year.	Silver.		Lead concentrates, silver-bearing.
	Quantity.	Value.	
	Fine ounces.		*Short tons.*
1907	25,692	$16,957	.....
1908	49,131	26,039	26,488
1909	14,188	7,378	31,000
1910	33,096	17,872	35,002

The quantities given in the first column of the foregoing table are those of recovered silver. The silver content of the ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied upon for the silver production. As may be seen by inspection of the table, the quantity of silver produced in any year bears no direct ratio to the quantity of

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concentrates smelted during that year. The reason for this is that the silver content is so small in quantity that the silver bullion is stored and refined in batches. If a series of years be taken into account, the concentrates are seen to average about 1¼ ounces of silver to the ton. The value is estimated at the average New York price according to the United States Mint.

PRODUCTION OF LEAD AND ZINC.

The total production of lead concentrates in Missouri in 1910 was 248,058 tons, valued at $11,286,750, as compared with an output of 249,536 tons, valued at $10,904,148 in 1909, a decrease of 1,479 tons in quantity but an increase of $388,987 in value.

Of the total production in 1910, 210,890 tons, valued at $9,360,309, was derived from southeast and central Missouri, an increase of 270 tons in quantity and of $537,012 in value. The average metal content of the concentrate in 1910 was 62.3 per cent compared with 60.9 per cent in 1909 and the value per ton $44.39, an increase of $2.50 per ton over 1909.

Shipments of lead concentrate from southwest Missouri were 38,531 tons, or 1,561 tons less than in 1909, and the value was $1,926,441, or $143,286 less. The carbonate of lead concentrates shipped amounted to only 197 tons, valued at $6,385, a decrease of 188 tons.

The average metal content of the lead concentrates from southwest Missouri was 79.8 per cent and the average price received per ton was $52, slightly less than in 1909.

The quantity of zinc blende concentrates sold by Missouri mines in 1910 was 232,341 tons, valued at $9,342,139, an increase of 3,318 tons in quantity but a decrease of $103,687 in value. All of the blende concentrates were produced in southwest Missouri. The average price per ton received was $40.21 and the average metal content was 59.2 per cent. The 1909 average price and metal content were $41.25 and 59.4 per cent, respectively.

The zinc carbonate and silicate concentrates sold in 1910 amounted to 23,826 tons, valued at $561,803. This was 4,699 tons less in quantity and $115,410 lower in value than the 1909 sales, a reduction of about 20 per cent.

The output in 1910 was almost entirely from southwest Missouri mines, the shipments from southeast Missouri being only 929 tons as compared with 1,284 tons in the year 1909. The average metal content of the zinc carbonate and silicate concentrates was 38.5 per cent in 1909 and 40.6 per cent in 1910. The 1910 average value per ton was $23.58 and that for 1909 $23.74.

The combined value of lead and zinc concentrates from southeast Missouri (which produced 85 per cent of the lead) was $9,379,309. The total value of the southwest Missouri lead and zinc concentrates was $11,817,768.

In the following tables showing the tenor of crude ore ("dirt") and concentrates from Missouri it has been considered advisable to segregate the ores of different nature. For instance, the disseminated lead ore from southeast Missouri differs radically from the lead and zinc ores from the so-called "soft ground" deposits of southwest Missouri, and these in turn differ from the "sheet ground" deposits of the same region. Each class of ore has its peculiar problems of

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mining and ore dressing. This fact makes desirable the separate treatment of the statistical data. Generally speaking, the tables reflect very closely the conditions of the industry.

Tenor of crude lead and zinc ore and concentrates produced in southwest Missouri, 1909–10.[a]

	1909	1910
"SOFT GROUND."[a]		
Total crude ore.....short tons..	3,096,789	3,275,705
Total concentrates in crude ore.....per cent..	4.0	4.4
Lead.....do....	.4	.4
Zinc.....do....	4.2	4.0
Metal content of crude ore.....do....	2.6	2.5
Lead.....do....	.3	.3
Zinc.....do....	2.3	2.2
Average lead content of lead concentrates.....do....	79.7	79.2
Average lead content of lead carbonate concentrates.....do....	43.6	47.6
Average zinc content of sphalerite concentrates.....do....	59.3	59.1
Average zinc content of silicates and carbonates.....do....	38.5	35.9
Average value per ton of lead concentrates.....	$52.37	$51.06
Average value per ton of lead carbonate concentrates.....	$28.89	$32.41
Average value per ton of sphalerite concentrates.....	$40.85	$39.40
Average value per ton of silicates and carbonates.....	$23.74	$23.58
"SHEET GROUND."		
Total crude ore.....short tons..	4,994,123	5,779,192
Total concentrates in crude ore.....per cent..	3.1	2.6
Lead.....do....	.5	.4
Zinc.....do....	2.6	2.2
Metal content of crude ore.....do....	2.0	1.6
Lead.....do....	.4	.3
Zinc.....do....	1.6	1.3
Average lead content of lead concentrates.....do....	80.3	79.9
Average zinc content of sphalerite concentrates.....do....	59.5	59.3
Average value per ton of lead concentrates.....	$54.41	$52.01
Average value per ton of sphalerite concentrates.....	$41.55	$40.81

[a] Including also the small production of lead and zinc ores in Central Missouri.

Tenor of crude lead ore and concentrates in southeast Missouri disseminated lead ore, 1909–10.

	1909	1910
Total crude lead ore.....short tons..	3,389,742	3,693,523
Lead concentrates in crude ore.....per cent..	6.2	5.7
Lead content in crude ore.....do....	3.8	3.5
Average lead content of lead concentrates.....do....	60.9	62.3
Average value per ton of lead concentrates.....	$41.89	$44.35

The main lead and zinc producing regions of Missouri are in the southwestern and southeastern parts of the State. The former is the greatest zinc-producing area in the United States. The latter contains the district of the disseminated lead ore, and in 1908 and 1909 exceeded in production the Cœur d'Alene region, which in recent years has held first rank in the United States. The central Missouri district has produced considerable ore in the past, but it is operated sporadically, and in 1909 and 1910 had so small a production that its output is included with that of southeastern Missouri. The silver and copper production of the State is limited to the southeastern district.

SOUTHWEST MISSOURI.

The southwest Missouri lead and zinc area includes the largest part of the Joplin region, the remaining portion lying in southeast Kansas and in northeast Oklahoma. The ore occurs in the Boone for-

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mation and in rocks of Kinderhook age, both belonging to the lower Carboniferous. The ore deposits are found in Jasper, Newton, Lawrence, Greene, and adjoining counties. This area produces about four-fifths of the lead and zinc ore raised in the Joplin region.

The lead ores are galena, with a small quantity of lead carbonate, locally known as "dry bone;" the zinc ores are sphalerite, or zinc blende, or "jack," zinc carbonate (smithsonite), and zinc silicate (calamine), both of the latter locally called "silicate." The galena contains but a small fraction of an ounce of silver to the ton of lead concentrates, and although ordinarily it is not desilverized, yet occasionally the refineries find it advantageous to add lead from the Joplin region to their charges, without, however, making any record of the silver content. In this way an unknown but small quantity of silver is recovered from southwest Missouri lead ore. The zinc ores, sphalerite, smithsonite, and calamine contain notable quantities of cadmium, being fully as rich in this respect as the zinc ores of Silesia, which are the source of the cadmium production of Europe. The discussion of the cadmium content of these ores is taken up more fully in the chapter in Mineral Resources for 1908 entitled "Cadmium."

The ore deposits of the Joplin district vary in character with the depth of mining. The shallower ores beginning at the surface are universally pockety, and are found in residual clays or in "runs" in the basal breccias of the region. The breccias and the forms of the "runs" are largely, if not altogether, due to solution of the limestone strata. One form of run which is fairly numerous is the "circle" deposit, which in the popular view has come to be nearly synonymous with rich deposits. Small veins, vertical sheets, and thin crevice deposits are often met with in prospecting, but unless they develop into stringers leading into paying ore bodies are forgotten in the multitude of rich pockety deposits which the district has yielded. The blanket deposits or "sheet ground" are found in the Grand Falls chert member of the Boone formation at depths varying from 125 to 275 feet, depending on the topography and the geologic structure. Below this horizon there are, in the rocks of Kinderhook age, deposits of disseminated ore. They have been struck in prospect shafts or drill holes near Springfield, Aurora, Granby, Carterville, Joplin, Hornet, and Cave Springs, in Missouri; at Galena, in Kansas; and at Quapaw, in Oklahoma. A report upon this lower ore horizon is in preparation by the United States Geological Survey.

ORE PRODUCTION.

Mining and milling practice in the Joplin region is so well known through the numerous articles that have appeared in the mining press of the country that but few words are necessary here. The type of mill erected in the district is carefully chosen to fit the needs of the particular kind of ore body to be exploited, and, being based on the evolutionary experience of nearly 40 years, is in general wisely selected.

In early days of zinc mining in the district when only the richest runs and pockets of the "disseminated" deposits could be profitably worked and the life of the individual mine was necessarily short, a very simple type of concentrating plant came into use. It was

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equipped with a rougher jig and a cleaner jig, and had a capacity of 80 to 100 tons of crude ore per 10-hour shift. When a deposit was worked out, the mill could be easily and cheaply moved to another deposit. When the increased price of concentrates made it possible to mine lower-grade ore and the life of the deposits was thereby lengthened, somewhat larger and more complete milling plants came into vogue. Sand jigs and concentrating tables were added to the equipment, and the capacity was raised to 200 or more tons per shift. Such mills, developed by the necessities of local conditions, came to be characterized throughout the lead and zinc regions of the Central States as the "Joplin type."

A further increase in the price of concentrates, and the development of large bodies of low-grade "sheet-ground" deposits, insuring permanence and stability of operation and necessitating every refinement of concentration, have resulted in the modern "sheet-ground mill" with capacity from 350 to 1,000 tons of crude ore per 10-hour shift, driven by steam, natural gas, or electricity, with complete equipment of ore-saving devices and with attendant economies of power, operation, and concentration.

ORE SELLING.

As was noted in the introduction to this chapter, the lead and zinc ores of the Central States when marketed locally are sold on a plan which differs somewhat from the methods in vogue in the Western and other States where more complicated ores prevail. The producer is paid by the ton of concentrates, all ores being sold in that form. The price is arranged on a sliding scale, the foundation of which is the price paid for ores of a certain standard, namely, the "basis." In each of the ores a "basis" is arbitrarily taken which represents as nearly as may be the average metallic content of clean concentrate. In sphalerite or zinc blende concentrate the basis is 60 per cent (theoretical composition, 67 per cent) of metallic zinc, by wet assay or analysis; in the oxidized zinc ores, the carbonate and the silicate, the basis is 40 per cent (theoretical, 52 and 54 per cent) metallic zinc; and in galena concentrates the basis is 80 per cent (theoretical, 87 per cent) metallic lead. The buyer will offer so much for 60 per cent zinc ore which becomes the "base price." If the assay shows the concentrates to vary from the basis, $1 is added to the base price for each per cent of zinc above 60 and $1 subtracted for each per cent less than 60. Deduction is made for moisture, all concentrates being sold on dry, or net, weight. Penalties are exacted for the presence of undesirable elements, as iron, bitumen, barite, fluorspar, etc. One dollar is deducted for each per cent of iron above 1 per cent. The first ore sold from the new Miami district was penalized 2 "per cent," that is, $2 was arbitrarily deducted for the bitumen clinging to the concentrates. The blende concentrates from Miami average about 50 per cent zinc and are penalized $10 per ton for falling 10 "per cent" below the "base," as well as an additional penalty for the iron contents. In practice, however, it has been found that these penalties are heavier than necessary and the ore buyers offset the excess by increasing the base offer over the base price obtaining in the other parts of the

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Joplin region where the concentrates average nearer 60 per cent. Fluorspar occurs in the zinc concentrates of western Kentucky and southern Illinois, but neither fluorite nor barite are found in quantity in the ores in the Joplin of the upper Mississippi Valley districts. The practice of buying zinc blende concentrates on an assay basis became general in 1899, though it began in a small way a few years earlier. Formerly the ore was bought on "flat bid;" that is to say, the buyer made a visual inspection and mental estimate of the metallic contents and then offered so much per ton for the particular concentrates in question. An expert buyer can estimate the metallic contents very closely. Galena concentrates are generally bought on flat bid, though buying on assay is increasing. Ore which is sold in lump, such as hand-picked galena, lead carbonate, and carbonate and silicate of zinc, is very generally sold on flat bid.

ASSAYS.

Several of the assayers in the Joplin district make a practice of saving the remnants of samples analyzed through the year. At the close of the year the lot is thoroughly mixed and carefully sampled, from which sample an average or composite assay for the year is made. Two representative series of such composite assays are given below. In most cases each sample included in the composite assay represents a carload lot of concentrates.

The first series, by W. W. Petraeus, of Joplin, gives the result of analyses of composite samples from the general district for the last 14 years. The analyses for 1897–1905, inclusive, were published in the Lead and Zinc News, volume 9, January 15, 1906, page 8. The analyses for 1906–1910, were kindly communicated by Mr. Petraeus. Iron was not taken into account until 1900. Some 400 scattering assays, made in 1895–96, are excluded from the table.

Composite assays of zinc blende from the Joplin region, 1897–1910.

[W. W. Petraeus, analyst.]

Years.	Composite sample.	Percentage of zinc.	Percentage of iron.	Percentage of lead.	Percentage of copper.	Percentage of cadmium.
	Lots.					
1897	600	56.64	.....	.....	.....	.....
1898	1,299	56.99	.....	.....	.....	.....
1899	3,715	56.67	.....	.....	.....	.....
1900	3,500	57.36	0.22	.....	.....	.....
1901	3,683	57.53	2.02	.....	.....	.....
1902	5,776	57.08	2.24	.....	.....	.....
1903	6,014	57.30	2.00	.....	.....	.....
1904	6,220	57.24	2.10	.....	.....	.....
1905	4,628	57.97	1.84	1.00	0.001	0.198
1906	5,644	57.2	2.00	.....	.....	.....
1907	6,813	56.8	1.93	.....	.....	.....
1908	7,837	56.4	1.76	.....	.....	.....
1909	9,002	56.3	2.00	.....	.....	.....
1910	8,892	56.6	2.10	1.02	.06	.399

The next series of composite assays was communicated by Prof. W. George Waring, of Webb City. The original samples were of ores from the different camps of the district except where otherwise indi-

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cated. The methods used in making these assays have been published.[1]

Composite assays of zinc blende from the Joplin region, 1900–1908.

[W. George Waring, analyst.]

Years.	Composite sample.	Zinc.	Iron.	Lead.	Cadmium.	Copper.
	Lots.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1900	3,894	57.30	3.03	.....	.....	.....
1901	5,172	56.00	3.30	.....	.....	.....
1901	2,757	55.30	3.86	.....	.....	.....
1901	[c] ±2,000	55.90	3.47	.....	.....	.....
1902	2,270	57.08	2.65	0.904	0.337	0.050
1903	2,145	57.75	2.32	1.072	.288	.049
1904	[a] 3,800	58.26	2.23	.701	.304	.049
1904	[b] 2,691	58.46	1.97	.720	.430	.050
1904	1,984	58.95	2.10	.....	.....	.....
1905	4,520	58.95	2.00	.....	.....	.....
1906	4,638	58.40	2.20	.....	.....	.....
1906	3,968	58.20	2.29	.....	.....	.....
1907-8	±4,000	58.70	2.00	.....	.....	.....
1909	.....	[c] 57.40	2.60	.....	.....	.....
1910	6,377	[c] 57.90	2.60	.....	.....	.....

[a] Joplin. [b] Webb City. [c] The composite sample included some lots of silicate ores.

The complete analysis of the composite sample of the 3,800 lots of concentrate from the Joplin district in 1904, sampled by C. V. Millar and analyzed by Waring, is as follows:

Analysis of composite sample of zinc blende from the Joplin region.

[W. George Waring, analyst.]

Zinc	58.26	Calcium carbonate	1.88
Cadmium	.304	Magnesium carbonate	.85
Lead	.70	Barium sulphate	.82
Iron	2.23	Silica	3.95
Manganese	.01		99.773
Copper	.049		
Sulphur	30.72		

Both series of composite assays show a slight but gradual increase in the zinc content of the concentrates from the beginning of the series to the present time. The second series indicates a similar decrease in the quantity of iron. Both these changes are doubtless to be attributed to the increased efficiency of mills and milling practice, particularly in the sheet-ground districts. The first series shows indications of a lowering of the grade of concentrates by the custom-mill product of the gougers and scrappers in the latter part of 1907 and in 1908, while many of the large mines were shut down because of the low price of ore.

PRICES AND PRODUCTION.

The yearly average price received in 1910 by producers for sphalerite concentrates was considerably lower than in the year 1909, while that received for carbonate and silicate concentrates and for lead concentrates was only slightly lower The average price of sphalerite or blende for 1910 was $40.21, as compared with

[1] Waring, W. George. The volumetric determination of zinc, Jour. Am. Chem. Soc., vol. 26 No. 1, January, 1904. In addition to the composite assays for 1902 and 1903, shown in the table, the article gives the lead, copper, and cadmium content of a number of ores from individual mines in Missouri, Kentucky, and Illinois.

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$41.25 in 1909; zinc silicate or carbonate (calamine) concentrates, $23.58 in 1910 and $23.74 in 1909. The average price paid for lead concentrates was $52 compared with $52.37 in 1909. These prices are not average base price quotations, but are the actual average prices calculated from the tonnage and values reported by sellers to the Survey.

The highest average quoted base prices for 60 per cent blende were in January and the lowest in July, ranging from $49 to $35 per ton. Calamine was highest in January and lowest in May. Base prices for lead concentrate ranged from $58 in January to $48 in the months of May and June.

There were many changes in the relative positions of the productive districts, an increased output in some and a decline in others. The changes on the whole were not extensive, but the lower prices of ore will probably have a great influence on the sources of the production in 1911. Although several large concentrating plants were under construction on sheet ground, the ore prices were certainly unfavorable for the extension of operations involving large expenditures to obtain and concentrate low grade "dirt." The continued low prices, however, had the tendency to stimulate the prospecting for rich ore in soft ground. This was more especially the case in the latter part of the year and probably will result in a larger percentage of the production coming from this type of ground, than has been the case for the last several years. The most important developments during 1910 were the numerous strikes of rich ore near Thoms Station, 2½ miles north of Joplin.

The Webb City-Carterville district, which includes many of the large sheet-ground mines, was much the largest shipper of both lead and zinc concentrates. It produced over 61 per cent of the lead concentrates and 45 per cent of the sphalerite sold in southwest Missouri in 1910. Although large, these proportions are smaller than in 1909, when they were 63 per cent and 47 per cent, respectively. The quantity of crude ore or "dirt" raised is a better indication of the extent of mining activity than the production of concentrates, for the sheet-ground ore is of much lower average tenor than "soft ground." If the total crude ore figures for each district were available, the leading position of the Webb City-Carterville-Prosperity district would be more adequately shown. Joplin, the second most productive camp in southwest Missouri, produced slightly less lead, but the production of blende and calamine both showed small increases.

The largest gain in zinc blende tonnage was made by the Alba-Neck City district. The shipments of zinc concentrates in 1910 were nearly double those made in 1909, and the district was the third largest producer, displacing Duenweg-Porto Rico, which was third in 1909. The production of lead at Duenweg-Porto Rico (over 8 per cent of of the southwest Missouri output) was so much in excess of that of the Alba-Neck City camp that the total value of the concentrates shipped was considerably larger than the value of the mine output for Alba.

The production of both lead and zinc concentrates increased at Oronogo, and the district was fifth in value of production. The much reduced shipments of calamine from Granby were more than offset by an increased output of lead and blende concentrates. The Aurora district showed a decline in all classes of ore; the total tonnage of con-

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centrates shipped in 1910 aggregated less than two-thirds of the 1909 shipments. Carl Junction shipments of blende concentrates were almost double those for 1909, and Sherwood production increased over 130 per cent.

The Spring City, Spurgeon, Cave Springs, Carthage, Sarcoxie-Reeds, Zincite, and Wentworth districts all showed a decline in 1910 in comparison with 1909.

REVIEW BY DISTRICTS.

Alba-Neck City district.—The largely increased production of zinc blende in this district in 1910 was due in a measure to the operations of a few prominent producers in the northwestern part of the camp. The production of lead concentrates was very small compared with that of zinc, and some of the largest shippers of zinc blende concentrate report no lead shipments whatever. The blende production of the Quick Seven Mining Co. in 1910 was the largest in the district and one of the largest in Missouri. Six shafts were utilized, including one new shaft 188 feet deep. The capacity of the concentrating plants is 600 tons daily. The lessees of the Reliance Mining Co. were the next largest producers. The other companies having large milling facilities and output were the Durston Mining Co., Cliffwood Mining Co., Frances Mining Co., and the Little Mary Mining Co. The production of the Little Mary was large for the time it was in operation, for the 300-ton mill was not completed until August. Other "turn-ins" (that is, ore sold and delivered) were made by the Dana Mining Co., Isabel Mining Co., Battle Axe Mining Co., Luke & Brown Mining Co., Penn Zinc Co., Red Fox Mining Co., Federated Mining & Milling Co., East Alba Mining Co., and N. C. Yanetin & Co. The 200-ton mill of the Good Day Mining Co. was idle the entire year.

Ash Grove-Everton district.—The mining in this vicinity is all shallow, none of the workings exceeding 50 feet. The shipments made were galena, lead carbonate, zinc carbonate, and silicate. Most of the lead was mined on the Duncan land in Boone Township. The zinc ore produced was mined by the Sturgess Mining Co., J. A. Hall, Harrison Mining Co., and other lessees on the leasehold of the Underwriter's Land Co., near Corry, a few miles north of Everton.

Aurora district.—Many mines in this district were operated intermittently in 1910, and the production was only about half of that for the year 1909. A great deal of the mining is on a small scale, and the ore is concentrated in custom mills. Coleman Bros. Mining Co. was much the largest producer; the ore treated in its 200-ton mill was mined at about 260 feet. The Coleman Bros. & Scott Mining Co. had a 150-ton concentrator in operation, which produced the next largest output. The output of both companies consisted wholly of high-grade zinc blende. Other producers reporting a good output of zinc blende were the Federal Lead & Zinc Co., Horine & Johnson, W. E. Stair, and W. H. Scott.

A fair output of both zinc blende and calamine was made by the Black Land Mining Co., Boston Aurora Zinc Co., Turner & Co., Cleveland Aurora Mineral Land Co., Decatur Lead & Zinc Co., and the Milton Mining Co.

The "turn-ins" from the land of the United Zinc Co. were mainly calamines ore, as were also those of the Midland Mining Co., the

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Southwest Missouri Mining & Milling Co., and the Springfield Aurora Mining Co.

Carl Junction district.—The largest portion of the output from this district was from the 60-foot open pit of the Moler-Smith Lead & Zinc Co. The ore handled is low in zinc, but the mine, worked as an open cut, in which a steam shovel is used a portion of the time, is operated at a low cost for labor and powder. The two concentrating plants in use have a capacity of 800 tons per day of 24 hours.

Other lessees on the Jubilee land recovered some blende concentrates.

Carthage district.—The production was less than in 1909, and there was not much activity in development work. The concentrates shipped were nearly all composed of blende. The Vesuvius Mining Co.'s lease on the Davey land was operated by N. C. De Vault, who was the leading shipper. There is a 200-ton concentrating plant on the property.

Other prominent producers were the Hayseed mine, operated by Douglas & Anderson, the Mignonette Mining Co. (which late in the year leased its mine and 300-ton mill to the Leonard H. Mining Co.), and the Weaver Tri-City Mining Co. (now owned by the S. V. & D. Mining Co.). The Texahoma Mining Co. on the Amsden land, only worked for a short period in 1910, and the mill on the Magnet Mining Co.'s property was burned down.

Cave Springs district.—The 1910 production in this camp was less than in 1909, but the camp will show better results in 1911. The principal property, that of the Herald Zinc & Lead Mining Co., was operated until August 12, 1910, the Herald 200-ton mill was then closed down and the property was transferred to the H. L. Kramer Mines Co. This company sank a 6 by 14 foot shaft to the 265-foot level, and equipped it with a double-cage system, the cars used holding 1 ton each. A completely equipped 500-ton concentrating plant was erected and put in operation shortly after the close of 1910. The Missouri Zinc & Lead Mills Co. (now known as the Big Browning Mining Co.) and McCullough & Murdock produced some blende concentrates.

Duenweg-Porto Rico district.—Despite the facts that much of the mining in this district is in the sheet ground, and that operators are more affected by low ore prices than in other camps, the 1910 production was slightly increased over that of 1909. The Trinity land was the largest producer. The Dauphin Mining Co. operated the 800-ton (per day of 24 hours) Trinity mill, and the old 250-ton Whitsett mill was run by the Carmean & Squires Mining Co.

On the Acme land the Church & Mitchell Mining Co. and the Jack Snipe Mining Co. made a fair output. The December tract of the American Lead, Zinc & Smelting Co. (on which the Vogey mill, having a capacity of 1,000 tons per day of 24 hours, is situated) was operated by the owners and by the Criterion Mining Co. The July tract, with its 600-ton plant, was operated by the Durston Mining Co.

The lessees on the Chase land made a good production. On the Chew land a large production was reported from the Mercantile Metal & Milling Co.'s lease, and a small quantity from the Federated lease. Another large producer was the Coahuila Lead & Zinc Co. on the Horton land. The mill on this property has a capacity of 300 tons per 10-hour shift.

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The Lincoln Mining Co., the Maple Leaf Mining Co., and the Wolfheart Mining Co. made a fair production from the Jasper County Royalty Co.'s land. The principal producers on the Knol land were the New York & Western Zinc Co., the Durby Lead & Zinc Co., the Nowata Mines Co. (No. 2), and the Delker Mining Co. The first and the last named companies erected mills during 1910.

The zinc carbonate and silicate concentrates produced in the district nearly all came from the R. L. McGee lease, on the Hall land, and the Emma C. Mining Co.'s lease, on the Sadtler land.

Smaller producers included Becker & Relling, Cadwell-Allen Mining Co., Boston & Duenweg Mining Co. land (on which the White Rat Mining Co. erected a 200-ton mill), the Marvel-Carnation and Henrietta leases on the Cosgrove land, Crown Crest Zinc & Lead Co., Old Colony Zinc Co., Grace Ping Mining Co., Hyde Park Lead & Zinc Co., Bonnie Pattie Mining Co., Sayers Mining Co., and Henry Weymann land.

Granby district.—The total production of this district in 1910 showed little variation from that of 1909. The production of silicate of zinc from shallow workings was less than in 1909, but the increased shipments of sphalerite concentrates more than counterbalanced the loss. Most of the producing territory belongs to the Granby Mining & Smelting Co., and the total tonnage from it was large, the relative quantity of zinc silicate, zinc blende, galena, and lead carbonate being in the order named. Much of the mining by individual operators and by small companies is in shallow workings and yields lead ore and silicate of zinc ore. The large lessees on Granby land, which contributed nearly all of the blende concentrates in 1910, were the Mascot Mining Co., Katy Mining & Milling Co., Golden Rule Mining Co., Little Boss Mining Co., Fortune Teller Mining Co., the Billiken Mining Co., and the Granby Sludge Co. The Mascot Mining Co. has a 100-ton mill on the Granby land and one of 150 tons on the adjoining Homestake mine. Other district producers were the Illinois Zinc Co., the St. Paul Mining Co., and the Little Four Mining Co.

Joplin district.—The number of producers reporting from this district is larger, the control of the land or mining leases is more diffused, and the area of operations more extended than in any other district in Missouri. The production is second to that of the Webb City-Prosperity district. The 1910 sales of concentrates were as follows: Galena 6,062 tons, lead carbonate 51 tons, zinc blende 47,200 tons, carbonate and silicate of zinc 1,403 tons. The total value of the concentrates was $2,243,273. As compared with 1909, the sales of galena and carbonate of lead declined 362 tons, zinc blende increased 1,237 tons, and carbonate and silicate of zinc increased 183 tons, and the total value was $37,084 less.

The largest production of lead ore and also of zinc ore was turned in by lessees of the Granby Mining & Smelting Co. This company reports that two new ore bodies have been discovered by drilling on the south half of the NE. ¼ sec. 33, T. 28, R. 33, and that shafts were being sunk to develop the ore body.

The second largest production of blende concentrates was produced by the Mandarin and Culpepper leases on the Cunningham land. Four shafts, ranging from 160 to 200 feet in depth, were in operation.

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The production of lead by lessees of the Rex Mining & Smelting Co. was very large, as was also the yield of blende concentrates. Large outputs of blende were also reported by lessees on the land of the Connor Realty Co., the Continental Zinc Co., St. Louis-Joplin Lead & Zinc Co., J. W. Ground, Leonard Realty Co., C. Lambert, Dirigo Land & Leasing Co., and Chicago-Joplin Mining Co. The Duquesne Mining Co., on the Mattes Bros.' land, operated a concentrating plant having a capacity of 400 tons per 10-hour shift.

The Bullfrog Mining Co., the Hemphill Mining Co., and the Harrison Mining Co. made large shipments. The Samson Mining Co. completed a new shaft to the 130-foot level, and at the end of the year was able to hoist ore from 3 shafts for its 350-ton mill. A moderate output of ore was made by the Anderson Mining Co., Allan-Courtad Mining Co., Hero Mining Co., Bash Development Co., Cox Mining Co., W. E. Johnson, Hercules Mining Co., Hecma Land & Mining Co., Paoma Mining Co., Rabbit's Foot Mining Co., Old Dominion Mining Co., United Zinc Companies (Chitwood eighty), S. S. Bissell, and the Rose Land Mining Co. The largest sales of zinc carbonate and silicate ore were reported by the Shoal Creek Mining Co.

There were many other smaller shippers having a large production in the aggregate. Low ore prices were severely felt by the sheet-ground operators, and several of the large concentrating plants were closed down before the end of the year. Among the number were the Muskingum Zinc & Lead Co., Hercules Mining Co., Hero Mining Co., Kitty Mack Mining Co., Cambria Mining Co. Three mills were erected and two mills were under construction in the West Joplin blanket ground. One, a 600-ton plant, by the Hackett Mining Co., was on ground newly opened up, and one of 400 tons capacity was on the Black Cat mine, owned by the Falls City Mining Co. Neither mill was finished in 1910. The mills in this camp that were completed during the year were the 250-ton mill of the Muskingum Lead & Zinc Co., the 500-ton mill of the Hercules Mining Co., and the 250-ton mill of the Kitty Mack Mining Co. C. C. Playter reopened land in Gordon Hollow that had been idle since 1900. Two concentration plants, having a combined capacity of 210 tons, were built and in operation the latter end of the year.

The Wilcox Mines Co. put down four drill holes near the old John Jackson mine at Chitwood, which showed ore faces of 25 feet of good ore, and a 145-foot shaft was sunk southeast of the old workings. A drift was cut to connect this shaft with the old mine, and a concentrating plant having a capacity of 400 tons per day was completed. The mine will be a large producer during 1911.

Oronogo district.—Most of the producing territory in this district is owned by the Granby Mining & Smelting Co. Only a very small part of the large production of ore in 1910 came from the shallow workings between grass roots and 70 feet, the ore bodies lying between 160 and 240 feet supplying most of the "dirt" hoisted.

The prominent lessees on Granby land that contributed to an output which was slightly in excess of that for 1909 were the Oronogo Circle Mining Co., Pinnacle Mining Co., and the Oronogo Mining & Development Co. In addition to these operators there were sundry scrappers who contributed to the shipments. The Granby Mining & Smelting Co. reported that a new run of ore has been developed at the 160-foot level of old workings on the NW. ¼ SW. ¼ sec. 31, T. 29,

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R. 32. Prospecting equipment was installed and some of the old workings unwatered, but no ore was concentrated.

The old Oronogo Circle mine, which has a long record of production, was much the largest producer in 1910. Steady development, moreover, opened up ore bodies sufficient to supply the milling plants with ore for some time to come. New methods of ore hoisting were devised to enable the company to utilize one concentrating plant longer hours and avoid using the other mills. A core drill was operated by this company on the 230-foot level. The cores obtained indicate a large body of good ore at depths of 250 feet to 380 feet. Drilling is to be continued during 1911 and a building will be erected to preserve in convenient form the section of the cores obtained.

Sarcoxie-Reeds district.—The production of this district, which was mainly zinc blende and zinc silicate in about equal quantities, showed a decrease of about one-fifth when compared with that for the year 1909. There was little new development work performed in the deeper mines which produce zinc. There were, however, several new shippers of zinc silicate and carbonate ores. N. C. Spencer & Co. shipped some calamine from the Webb land 4 miles west of Sarcoxie, and a smaller quantity was shipped from the Clark land 5½ miles west. The greater portion of the calamine ore shipped was mined on the Cale and H. B. Boyd lands.

The Cameron Mining Co., on the J. W. Boyd land, with a concentrating plant of 300 tons capacity, turned in a large production of high-grade blende concentrate. The Plymouth Rock mine, on the Ravenswood lease of the Goucher land, was operated for only about six months in 1910. Other blende producers were the Red Fox Mining Co. on the W. H. Smith lease and the Log Cabin Mining Co.

Sherwood district.—This district had a much larger production of both lead and zinc concentrate than it had in 1909. It includes the Thoms Station Camp, situated 2½ miles north of Joplin along the Kansas City Southern Railroad. In the latter part of 1910 rich strikes of ore were made on the Brinkerhoff, the Mexico-Joplin, and other lands. Owing to the desirability of soft ground leases these strikes were the beginning of a very active period of prospecting. The drilling extended over a large area of ground, some of it virgin, but in many cases on tracts that had been drilled in former years to depths short of 150 feet. By the end of the year nearly every available lease had been secured, and as in order to hold them the land had to be drilled, rigs were rushed in from every part of the Joplin region. None of the mines developed late in the fall shipped ore in 1910, but several leases had mills under construction, shafts were rapidly going down and being equipped, so that the district will show a largely increased output in 1911. Among the 1911 producers will be the important Sitting Bull Mining Co. on the Brinkerhoff land, Bucyrus Mining Co., West Mining Co., Chapman & Lennan on the Coble land, and many others.

A number of lessees on the 560-acre tract of the Mexico-Joplin Mining Co. shipped the bulk of the ore credited to this district, and many of the strikes made late in the year were located on this land. The Katherine Lease Co., which was the first mine developed, had a large production. The shaft on this lease is 172 feet deep, and the concentrating plant has a capacity of 150 tons for 10 hours. The Mary C. Mining Co. also was a large producer and built a new 150-ton

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mill. Other producing leases were those of the Maud V. Mining Co., Kittrel & Co., and Merritt & Lant. The ore on the last-named lease is very rich, and concentrate was recovered by means of hand jigs. The High Tariff Mining Co. lease, which adjoins that of Merritt & Lant, was equipped with a 100-ton electrically equipped concentrating plant. There was no production from the 160-acre tract of the Alamo Land & Mining Co., but many leases were granted, and some of these will probably ship ore in 1911.

The remaining production of the district in 1910 was derived from the W. E. Johnson land and from that of the Excelsior Zinc & Lead Co. The names of the lessees, depth of shaft, and capacity of the concentrating plants on Excelsior land were as follows: Babson, Batten & Cox, 125 feet, 200 tons; Wise Mining & Development Co., 145 feet, 100 tons; Gouvernour Lead & Zinc Co., 125 feet, 200 tons; Homestake Mining Co., 125 feet, 200 tons.

Spring City-Beef Branch district.—The production of lead concentrates, both galena and carbonate, and of zinc blende were slightly less in 1910 than in 1909, but sales of zinc carbonate and silicate increased. The largest quantity of lead and of blende concentrates was reported by lessees on the Adam Scott lease of the McCown land. The principal sublessees were Creech & Co. (old Delta), and the U. G. Wilson Mining Co. (now the Spring City Lead & Zinc Co.). There were 5 shafts in operation and 3 new ones were being sunk. There were also 5 milling plants, with a total capacity of 355 tons, on the lease. The lessees on the J. W. Allen land, including the Sunrise, Malang, Fairview, Oak Ridge, and Lone Hickory, made the largest tonnage of carbonate and silicate of zinc concentrates in addition to a good production of lead and zinc blende.

The Mary E. Mining Co., operating on the Haines land, built a 100-ton plant and milled ore from the 130-foot level. The resulting concentrate was low grade, for no attempt was made to separate the blende and the silicate which occur together in the ore body. The McKinney lease, on the Hoge land, made a large output of zinc silicate. Other producers of this kind of ore were the Zeta Land & Investment Co., Henry Weyman, Davenport Mining Co., J. M. Lambert (Georgia lease), Bales land, Chalmondeley land, and the Leake land.

The Lakeview Mining Co. and McRuer & Co. on St. Paul Mining Co. land and the White Oak Mines Co. on the Sulphide Corporation land produced some lead and zinc blende.

Springfield district.—As there was only one producer in this district located on Pierson Creek, about 5 miles southwest of the city, the production given in the table includes the output of the few mines in Howell and Barry Counties. The single producer at Pierson Creek was the Bray Mining & Milling Co., which in November, 1910, reopened the Daisy mine which had been closed since October, 1909. The mill on this property is of 75 tons capacity, and the ore is galena and sphalerite, the concentrates of the former assaying 82 to 83 per cent, and the zinc concentrates assaying 63 per cent.

The only producing mine in Howell County was the Alice mine, on the SE. ¼ sec. 12, T. 22, R. 11, owned by the Empire Zinc Co. The production was large, but only a very small portion of the ore was shipped in 1910. The ore is a carbonate of zinc, carrying limonite, which crops out at the surface, and was worked down to a depth

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of 60 feet in a large open pit; there is ore still showing in the bottom of this open cut. The carbonate was treated in a log washer having a capacity of 200 tons per day.

In the McDowell camp in Barry County there were 2 producing properties in 1910. The Henry Woods Mining Co., after making some shipments of calamine, discontinued operations. The Metropolitan Mining Co., leasing the Queen City Mining Co. land, shipped a small quantity of lead and of high-grade blende concentrates. The Jersey Fissure Mining & Milling Co. purchased from the Metropolitan both the land and the 150-ton mill and mine equipment late in the year and sunk a new shaft to the 130-foot level.

Spurgeon district.—The principal production of this district in 1910 was galena and carbonate of lead concentrates, which amounted to 797 tons, having a value nearly double that of the zinc concentrates. A very large part of this lead output was recovered by the Silver Dime Mining Co., which operated 3 hand jigs on the O'Neill land.

Most of the zinc blende and silicate concentrates shipped were mined by the Hindman, Goodwin, and Estawawa lessees on the Granby Mining & Smelting Co. land. These leases also shipped a large quantity of lead concentrates. There are four 90-foot to 100-foot shafts and two 100-ton concentrating plants on the Granby property. The Bucklen, the Bucklen & Wills, and the Becker lands made only a few shipments of ore.

The Home Mining Co. and the Lost Creek Mining Co., operating near Seneca, made shipments of lead ore.

Stotts City district.—The ores in this district are practically all zinc blende, only a little galena occurring in one of the mines.

The largest producing property in the camp was the Gundling Zinc & Lead Co., which shipped a little lead and a good tonnage of blende concentrates. The ore body is opened by three shafts. Two of these are 230 feet deep and the other was sunk to 300 feet during 1910. A 300-ton concentrating plant was also constructed and operated the latter part of the year. The only leases on the Stott land shipping ore in 1910 were the Keystone and the Mystic Valley. The Keystone made the most of the concentrates, although its 125-ton mill was only operated for five months.

Webb City-Carterville-Prosperity district.—This district includes most of the original and typical sheet-ground territory, and the low prices for ore reduced the production to some extent, although the decline was not as large as was expected. Quite a number of the sheet-ground mines were closed down the latter part of the year. Doubtless in some cases the low price of blende concentrates caused the mining to be unremunerative, but the desire to reduce production in the hope that scarcity of concentrates would cause a stronger demand contributed to temporary shutdowns.

Among the companies which ceased to operate were the Ground Floor Mining Co., Mammoth Zinc & Lead Works (whose plant was sold and removed from the lease), Glass Lead & Zinc Co., Carbondale Mining Co., Engineers Zinc Co., Ava Maria Mining Co. Many mills, including those on the Bull Dog, Red Dog, Dinger, Good, Missouri Mule, Providence, and Continental, were idle a part of the year.

The production of lead concentrates in 1910 was 22,772 tons, 1,603 tons less than in 1909. The production of blende concentrates

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in 1910 was 104,788 tons, a reduction of 4,525 tons when compared with that of 1909. The total value of the concentrates sold was $5,465,563 in 1910 and $5,847,215 in 1909.

Lessees on the Guinn land reported the largest production of zinc ore and the second largest production of lead ore. The output from this one tract of land was only exceeded by that of three mining districts in southwest Missouri. The aggregate capacity of the 16 concentrating plants on this land (including tailing and sludge mills) was in excess of 4,000 tons per day, and 27 shafts were in operation. The leasing companies on the property include the Mercantile, Osceola No. 2, Home Run, Electrical, Empress No. 2, Ice Plant, Rhea, Moark-Nemo, Realization, and Ground Floor.

Davey mines Nos. 1, 2, 3, and 4 in the vicinity of Prosperity, equipped with 4 double-compartment shafts and 4 concentrating plants, having a combined capacity of over 3,500 tons per day of 24 hours, were operated by the American Zinc, Lead, & Smelting Co. This land was the largest lead producer in the district, and second only to the Guinn land in zinc output. The Hockaday tract, belonging to the same owners, was worked by the Sneed Mining Co. and other lessees.

In the territory between Webb City and Carterville the Bradford Kansas City Mining Co., with its lessees (Empress No. 1, Dinger, and Disbrow), and the Center Creek Mining Co. lessees, both reported very large outputs. The Comet Mining Co., one of the Center Creek lessees, sank a new shaft and built a new milling plant. The production of the Underwriters Land Co. from the Worthington land was very large. The milling capacity is about 1,200 tons per day of 24 hours.

The Red Dog, Bull Dog, and C. C. & H. leases on the Rochester Land & Leasing Co.'s property were in active operation and their output of ore was large, as was that of the lessees of the Charles A. Byrd land, including the Good, the Thornton, and the Old Dominion.

Other companies operating in the sheet ground north of Webb City and producing heavily were the Providence Mining & Milling Co. on the Ashcraft land, the Golden Glow Mining Co., the lessees of the Kelley Land Co., the lessees of the Bowman Ware & Scott land, and the Vantage Mining Co. New mills were built on the Kelley land by the Smithfield Zinc Co. and the Bohemian Girl Lead & Zinc Co.

The Continental Zinc Co. produced large quantities of lead and zinc concentrates from the Litteral tract at Prosperity. The Aylor land, the Eleventh Hour Mining Co. land, and What Cheer Mines Co. land were also very productive.

Other prominent shippers in 1910 were the Doane Mining Co. on the Chinn land, the lessees of the Connor Realty Co., the Federated Mining & Milling Co., the Athletic and Winslow leases on Newell Morse Royalty Co. land, the Nowata and Gibson leases on the Pike Land Co., and the Prosperity Land & Mining Co.

The properties forementioned comprise merely the most productive ones during 1910. There remains a long list of mines upon which development work was done or which made outputs varying from small to quite important.

Wentworth district.—Although the 1910 production of this district was small, the development work done gave promise of a

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larger yield in 1911. Much of the zinc silicate concentrates shipped came from the Mocking Bird mine on the Poland land. The ore mined occurs at the 80-foot level and was shipped without treatment. The mine has a good face of sphalerite, but, as there was no milling plant, the ore was not hoisted. Lessees of the Empire Zinc Co. on the Gormley land made a small production. Later in the year this lease was abandoned and the two 150-ton mills were sold.

On the Bowen land 2 shafts were sunk locating ore runs at 46 to 71 feet. Hand jigs and other equipment were installed at the Independence shaft by Whitten & Dugan, and in July, 1910, the Wentworth Land & Mining Co. commenced the erection of a 150-ton mill (known as the Alice Dayton mill), which was ready for use early in 1911.

Zincite district.—There was very little new work undertaken in this district in 1910, no new mills were reported as built, and the production of blende concentrates declined 1,117 tons.

The most important production of both lead and zinc ores was that made by the Clara Belle Mining Co. on the Parkinson Graves & Harper land. The lessees of the Belville Land & Mining Co. made a good output of blende concentrates and smaller shipments were made by lessees of the Geneva Land & Mining Co., O. & C. M. De Graff (Brooks land), General Lead & Zinc Co. (Claycomb land), Holy Moses Mining Co. (Leckie land), and the East Hollow Mining Co.

CENTRAL AND SOUTHEAST MISSOURI.

By C. E. Siebenthal.

The ore deposits of central and southeast Missouri reach in a more or less connected belt from the region of Morgan, Moniteau, Cole, and Miller counties on the northwest to the northern and eastern flanks of the St. Francis Mountains on the southeast. It is also true that there are scattered areas where more or less mining has been done all the way between the northwest end of this belt and the Joplin region, so that strictly speaking the lead and zinc deposits of Missouri practically form a zone around the northern half of the Ozark dome.

The deposits in the counties named above, corresponding to the central Missouri region, are of the general type of those in the Joplin region, in that the ores consist of galena and sphalerite, or the oxidized derivatives of those minerals, and occur in association with solution breccias and sink-hole shale patches, the ore being found in the Cambrian and Ordovician dolomites and included cherts and occasionally in the Pennsylvanian shale. The occurrence of ore in crevices or thin vertical sheets is very common, but practically all the production of ore has been from sink-hole breccias or "circles," a form of deposit noted also as important in the southwest Missouri area.

The southeastern part of the belt, in the vicinity of the St. Francis Mountains, forms the disseminated lead region of southeast Missouri. The southeast Missouri deposits have been known and worked for about 200 years. The earlier workings were shallow, and even yet considerable shallow lead is raised, generally in connection with the mining of barytes, or "tiff," as it is locally known. The mines in the disseminated lead region range from 100 feet to about 550 feet in

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depth, depending on the depth from the surface to the basal portion of the Bonneterre limestone.

The ore deposits now worked are almost wholly in the lower part of the Bonneterre limestone, where they occur in disseminated form over large areas, relatively richer in the vicinity of the intersecting crevices and joints. The crevices show little if any displacement, and there are no breccias of consequence. The copper, nickel, and cobalt in Madison County occur with galena and marcasite in blanket formation in the carbonaceous beds of parting at the contact of the Bonneterre limestone with the Lamotte sandstone below, and in the vicinity of the intersection of this contact with the sloping surface of the pre-Cambrian rocks. Both the Bonneterre and the Lamotte formations are of Cambrian age.

Prospecting is done by means of the diamond drill, and extensive campaigns of drilling have been prosecuted in the vicinity of all the important producing tracts. Just before the business depression in 1907 there were about 100 diamond drills actively engaged in prospecting. In 1908 and 1909 very little drilling was done, other than that necessary in mining. In 1910 drilling became somewhat more active and several tracts were prospected. The diamond drill is also used in mining as an aid in following the ore. Cores are taken from the heading in various directions, straight ahead, at angles upward, downward, or to the side, and from these cores the direction to drive the heading is determined.

The ore in the southeast Missouri region is almost wholly lead, although a considerable zinc deposit occurs at Valle mines, some 6 miles north of the Bonneterre district. A certain percentage of zinc is also found in the disseminated lead ore, the ore from one shaft being reported to run occasionally as high as 2 per cent of zinc for a week at a time. The zinc occurs more plentifully in the Leadwood-Flat River districts, and may lie near the contact of the Bonneterre limestone with the Lamotte sandstone or some distance above it. In the lead concentrates zinc ranges from 1 to 5 per cent, or more. In the maximum proportions mentioned, the zinc makes trouble in lead smelting, and for this reason some of the concentrating plants remove the zinc as a table middling. As the quantity of zinc is increasing it will no doubt before long become a salable product of the district. In one mill now operating, middlings, containing 20 per cent of zinc, are being discarded at the rate of a ton daily. An interesting feature of the zinc middlings is that they carry a disproportionately large part of the silver content of the ore, the silver being apparently associated with the zinc rather than with the lead.

Copper, nickel, and cobalt also occur in the ore, in greater quantity in the vicinity of Fredericktown, and in smaller quantity, irregularly, in nearly all the deep mines. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district and in some instances has been a source of income.

The lead ore of southeast Missouri carries a small proportion of silver, the average being a very little over 1 troy ounce to the ton of lead concentrates. The resulting pig lead likewise carries silver, together with a little copper, nickel, cobalt, and traces of antimony and arsenic, and is sometimes commercially known as "Missouri chemical"

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lead in contradistinction to "Missouri soft" lead from the Joplin region. An average of about 15 per cent of the total lead concentrates from southeast Missouri is desilverized. The silver so recovered does not pay for the refining charges, but the desilverized lead commands a slightly higher price, making up the difference. As the silver content of the concentrates is so small it is disregarded in their sale, and therefore the smelter reports are relied upon for the silver production. As explained already, the quantity of silver produced during any year bears no direct ratio to the quantity of silver-bearing lead concentrates smelted during that year, for the reason that the silver bullion is stored and refined in batches at convenient times.

The silver production of southeast Missouri was 33,096 fine ounces in 1910, as compared with 14,188 fine ounces in 1909, and 49,131 ounces in 1908. The silver production for 1910 was recovered from 35,002 tons of lead concentrates, that for 1909 was recovered from about 31,000 tons of concentrates, and that for 1908 from 26,488 tons of concentrates. The crude ore in 1910 yielded 5.7 per cent of lead concentrates, which averaged 62.3 per cent of lead. The average value per ton of the lead concentrates in 1910 was $44.35, as compared with $41.89 per ton in 1909.

REVIEW BY COUNTIES.

Moniteau County.—The Monarch Coal & Mineral Co. is working a thick pocket of cannel coal near Excelsior by means of an open cut 95 feet in depth and a shaft 124 feet in depth. Considerable lead and zinc is found, chiefly in breccias adjacent to the coal and shale, though not much ore has been mined in the last three years. It is reported that in the recent workings the shale underlying the coal is well mineralized, and the small mill has been remodeled to effect a better separation of the ore from the coal and shale gangue.

Franklin County.—A small quantity of hand-sorted lead ore was shipped from the Wrisberg mine. The shaft is 100 feet in depth, and the ore body, apparently a crevice deposit, is reported to be opened up for a distance of 600 feet both north and south from the shaft. A crosscut is reported to intersect another crevice deposit at a distance of 392 feet. A large quantity of milling ore is stored on the surface pending the completion of a 60-ton concentrating plant.

Washington County.—Several companies owning large tracts of land in Washington County, as the Washington Land & Mining Co., the Southeast Missouri Lead Co., and the Potosi Lead, Baryta & Mercantile Co., formerly the Nina Realty Co., work their property on a royalty basis. The ore which occurs at shallow depths and in association with barytes is mined in a small way and at odd times by the barytes miners. This ore is all hand picked and cleaned, there being no concentrating plants. There are numerous other shallow lead and barytes diggings scattered over Washington County which are worked by small operators and farmers who sell their product to the country merchants.

Jefferson County.—The Valle Mining Co. also operates on a subleasing or royalty system a large tract of land in part in St. Francois County. The ores are galena and zinc carbonate and are found at depths ranging up to 190 feet, depending on the topography. There were 12 shafts in operation in 1910 and a good production of ore was

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made. On the tract there is a small Scotch-hearth lead furnace which has not been operated for several years, and an oven in which the zinc carbonate ore is calcined before shipment. The land was prospected during 1910 by a number of diamond drill holes. The following section of drill hole No. 1, about three-fourths of a mile nearly due south of Valle mines station, as interpreted by the Missouri Bureau of Geology and Mines, has been furnished by the Valle Mining Co:[1]

Section of drill hole No. 1, Valle mines, Jefferson County, Mo.

	Feet.
Surface	9
Potosi	227
Derby and Doe Run	94
Davis shale	170
Bonneterre	240
Total depth	740

St. Francois County.—The mines of the St. Joseph Lead Co. are all but one located at Bonne Terre and Leadwood, the exception being shaft No. 8, which is near Flat River Station. There were 9 shafts in operation in 1910 and the production was greater than ever before. These mines are all upon spurs of the Mississippi River & Bonne Terre Railway, a subsidiary organization, and are thus connected with the mills and smelter of the company. The two concentrating plants, the Hoffman mill at Leadwood and the St. Joseph mill at Bonne Terre, have a combined capacity of 3,000 tons of crude ore in 24 hours. The Hoffman mill is modern, but the St. Joseph mill is of an older type. It is equipped with Parsons and Harz jigs and cushion tables. The crushing department was electrified late in the year and eventually the mill will be electrically driven throughout and otherwise remodeled by the substitution of Hancock jigs and Wilfley tables. The new producer-gas engine electric power and compressor plant is planned with space for the installation of sufficient equipment to drive the mines and mill from the central plant. Underground haulage is by means of compressed air locomotives. A drift was started from the mine at No. 7 shaft, 1 mile southwest of Bonne Terre, to connect with the main underground workings at Bonne Terre, with the object of establishing underground haulage and abandoning the independent hoisting and pumping plant at No. 7. The smelter at Herculaneum, on Mississippi River near the northern terminus of the Mississippi River & Bonne Terre Railway, is equipped with 4 large Dwight & Lloyd sintering machines, 28 Savelsberg roasting and sintering pots, and 5 blast furnaces, with appropriate drossing kettles, etc.

The Doe Run Lead Co.'s mines are at Doe Run and near Flat River, except the Mitchell shaft, which is about 3 miles west of Flat River. The 3 concentrating plants have a combined capacity of 2,850 tons of crude ore per day of 24 hours. The older mill at Esther is not now operated, all concentration being made on the mill at Doe Run or on the new steel electrically driven mill near Elvins. This new mill is built in 4 sections of 500 tons capacity each. It is equipped with dry crushing machinery, classifiers, Harz and Hancock jigs, Huntington

[1] Letter dated July 22, 1911.

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mills, Wilfley tables, and Frue vanners. Several hundred tons of copper concentrates were shipped from the Doe Run mines in 1910, recovered as middlings in concentrating the lead. Besides copper the concentrates contained nickel, cobalt, and a little silver, but these were not recovered in smelting the copper. The producer-gas engine electric power plant at Central is a duplicate of the St. Joseph plant, except that it lacks the compressors. Haulage in the widely separated mines of the Doe Run Co. is by mules. Shaft No. 10 was completed at Esther and No. 11 was started at Doe Run. Seven other shafts were in operation and the production of concentrates was largely increased.

The Desloge Consolidated Lead Co. in 1910 operated 3 shafts, 2 of which are each 280 feet and the other 500 feet in depth. Two of the shafts are near the town of Desloge, but No. 4 shaft is near Leadwood. During 1910 the concentrating plant was remodeled, and is now equipped with 3 Hancock jigs, 30 Wilfley tables, 10 Frue vanners, and appropriate rolls and Chili mills. The capacity is 1,200 tons per day of 24 hours. A large quantity of lead concentrates was produced, a portion of which was smelted in the company's smelter near the concentrating plant. The smelter is equipped with 4 Flintshire-Tarnowitz reverberatory furnaces, 2 hand-rabbling reverberatory roasting furnaces, and 1 small cupola blast furnace, with drossing kettles, etc. In recent years none of the furnaces, except 2 of the Flintshire furnaces, has been worked, the "gray" slag being sold to other smelters.

The St. Louis Smelting & Refining Co. has its mines in the vicinity of the village of St. Francois, about 1 mile north of Flat River. Four shafts, ranging from 328 feet to 407 feet in depth, were in operation in 1910. A new shaft, No. 6, one-fourth mile west of Flat River, was sunk during 1910. The bottom of the ore was reached at 540 feet and the Lamotte sandstone at 560 feet. The concentrating plant is modern, having a capacity of 1,600 tons per day of 24 hours and being equipped with Hancock jigs, Richards classifiers, Huntington mills, Overstrom and canvas tables, Frue vanners, slime and settling tanks. A central steam-power plant drives air compressors and electric generators. The mill, hoists, and pumps are operated by electricity, as well as the underground haulage and the electric trams for handling the ore from the shafts to the mill. This company also operates a lead smelter and refinery at Collinsville, and the lead concentrates produced by the mines were smelted at that plant.

The Federal Lead Co. operated 7 shafts during the first half of the year and 5 shafts during the last half. These mines are in the vicinity of Flat River, Central, and Elvins. The average depth of mining is about 400 feet. A large increase was made in the production of lead concentrates in 1910. There are 2 concentrating plants, one of 1,200 tons and the other of 3,600 tons rated capacity, but really developing 4,000 tons capacity per day of 24 hours. The smaller mill was idle in 1910, but the larger one was operated continuously. It is of best modern type, with a full complement of crushing machinery, Hancock jigs, Richards classifiers, Wilfley tables, Frue vanners, and slime separators. These are arranged in 6 units. Separate from the mill there is a series of slime settling tanks, the pulp from which is treated on canvas slime tables. Power for mining and milling is furnished from a central power plant which adjoins the large mill, and is

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equipped with water-cooled steam turbine-driven electrical generators. Electrical haulage is installed underground.

The Potosi Mining Co. took an option to purchase the Jake Day tract of 358 acres at Leadwood after a campaign of core drilling. A shaft was begun which had reached a depth of 150 feet at the close of 1910, when the option was exercised and title to the property changed hands at a valuation said to be $318,000. The shaft is to reach a depth of 420 feet. It is reported that the same interests which make up the Potosi Mining Co. also control the large mining tract of the Potosi Lead, Baryta & Mercantile Co.

Madison County.—The Mine La Motte Lead & Smelting Co. operated steadily during 1910 on a tract which was first mined in 1720. The shallow deposits which were first worked were followed down to a depth of 100 to 125 feet, from which level the ore has been coming which for 50 years has supplied the mill and smelter. No. 4 shaft has now reached a depth of 170 feet. No. 5 shaft, near No. 3 mine, was completed during the year, and another shaft decided upon. The mill, which is practically new, has a capacity of 500 tons per day of 24 hours. The old 250-ton mill and the 400-ton mill of the Wheeling Milling Co., on the same tract, were not in operation. The smelter has likewise been idle for several years. The attempt was made some years ago to smelt the copper and nickel-cobalt sulphides, which in certain parts of the mines occur plentifully with the lead and are separated in concentration. Of late years these ores have been avoided and attention in mining has been limited to the lead ores. The lead smelter has not been operated for several years.

The Eastern Lead Co., formerly the Hudson Valley Lead Co., was overtaken by financial difficulties in 1909 and was sold under foreclosure, the purchaser being A. Dempster, of the Mine La Motte Co., on whose land the Eastern Lead Co. was operating under lease. The Eastern Lead Co.'s mill has a daily capacity of 225 tons, but was not in operation in 1910. The mine is worked both by shaft and by incline. Considerable mixed copper-cobalt-nickel sulphides occur with the lead in the mine.

The Madison Lead & Land Co., operating what was formerly known as the Catherine mine, was declared bankrupt in 1909, and the property was sold in January, 1910. It was bought in by the bondholders, who reorganized the company under the name of the Phoenix Lead Co. The year closed with no operation and with the future of the property uncertain. The mine is worked from two shafts, 130 and 160 feet in depth, respectively. There are two mills, an older one of 200 tons capacity, located on the Little St. Francois River and connected with the mine by a long aerial tramway, and a newer 500-ton mill located at the mine. A peculiarity of the mine has been the occurrence of huge mud pockets which, when broken into, flow out into the mine and fill the drifts.

The North American Lead Co. closed down in January, went into a receivership in April, and was sold in November, being bought in by the Canadian bondholders. The ore mined consists of an intimate mixture of the sulphides of copper, lead, nickel, cobalt, and iron in the form of chalcopyrite, galena, limonite, and pyrite. As reported by the receiver of the property, the metals have the following proportions in the ore: Copper, 2.5 per cent; lead, 2 per cent; nickel, 1 per cent; and cobalt, 0.5 per cent; in all, 6 per cent of metallic content.

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In reducing this ore, the lead is removed as far as possible in milling and sold as galena concentrates; the mixed copper-nickel-cobalt sulphide concentrates are roasted and smelted and finally separated by electrochemical means. The capacity of the smelter is 180,000 pounds of copper, 60,000 pounds of nickel, and 20,000 pounds of cobalt oxide per month.

OKLAHOMA.

By J. P. DUNLOP.

PRODUCTION.

The production of lead and zinc in Oklahoma in 1910 is shown in the following table:

Production of lead and zinc in Oklahoma in 1910, by districts, in short tons.[a]

District.	Ores.								Metal content.			
	Lead concentrates.				Zinc concentrates.				Lead.		Zinc.	
	Galena.		Carbonate.		Sphalerite.		Carbonate and silicate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ottawa County:												
Miami	3,364	174,134	....	.....	10,055	294,877	.....	.....	2,674	235,312	4,307	465,165
Peoria	3	160	1	42	.....	.....	65	1,404	3	264	23	2,484
Quapaw	270	13,727	....	.....	3,921	152,166	.....	.....	211	18,568	1,998	215,784
Total	3,637	188,021	1	42	13,976	447,043	65	1,406	2,888	254,144	6,328	683,424
Murray County	.....	.....	....	.....	.....	.....	215	4,166	.....	.....	66	7,128
State total:												
1910	3,637	188,021	1	42	13,976	447,043	280	5,572	2,888	254,144	6,394	690,552
1909	4,306	223,377	....	.....	16,584	568,614	453	10,627	3,427	294,722	7,806	843,048
1908	2,236	118,333	....	.....	10,038	249,991	280	6,625	1,781	149,604	4,529	425,726
1907	662	44,771	5	275	3,076	119,008	650	15,667	532	56,392	1,657	195,526

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc, but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

The following table gives the crude lead and zinc ore for the whole State of Oklahoma, but it was thought advisable to calculate the tenor of crude ore and concentrates as well as assay content and value of concentrates separately for the Miami and the Quapaw districts, inasmuch as the character of the ground operated in these districts differs so radically that general calculations for the State would be valueless. The marked increase in the value of blende concentrates at Miami in 1909 as compared with 1908 was due to several factors, among which are: The higher grade of the concentrates, less bitumen, and more favorable base offerings on account of high iron content, as well as the prevailing higher price of blende in 1909.

In 1910 the lead concentrates produced showed very little difference in lead content or in value from those of 1909. The zinc concentrates, however, were of lower grade and the average selling price was $1.88

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less per ton than in 1909, but $7.77 per ton greater than in 1908. The sphalerite concentrates from the Quapaw district were equal in grade to those produced in 1909 but sold for $2.58 less per ton.

Tenor of lead and zinc ore and concentrates produced in Oklahoma, 1909–10.

	1909	1910
Total crude ore.....short tons..	317,574	223,212
Miami district:		
Total concentrates in crude ore.....per cent..	9.2	11.8
Lead.....do....	2.4	2.9
Zinc.....do....	6.8	8.9
Metal content of crude ore.....do....	5.3	6.7
Lead.....do....	1.9	2.4
Zinc.....do....	3.4	4.3
Average lead content of lead concentrates.....do....	79.0	79.5
Average zinc content of sphalerite concentrates.....do....	50.3	48.7
Average value per ton of lead concentrates.....	$51.92	$51.76
Average value per ton of sphalerite concentrates.....	$31.21	$29.32
Quapaw district:		
Total concentrates in crude ore.....per cent..	3.7	4.0
Lead.....do....	.2	.3
Zinc.....do....	3.5	3.7
Metal content of crude ore.....do....	2.2	2.4
Lead.....do....	.2	.2
Zinc.....do....	2.0	2.2
Average lead content of lead concentrates.....do....	79.3	78.2
Average zinc content of sphalerite concentrates.....do....	57.9	57.9
Average value per ton of lead concentrates.....	$51.41	$50.84
Average value per ton of sphalerite concentrates.....	$41.39	$38.81

The shipments of both lead and zinc concentrates from Oklahoma mines declined appreciably in 1910. The lead concentrates sold were 668 tons in quantity and $45,314 in value less than those sold in 1909. The sales of sphalerite and of zinc carbonate concentrates were both less than in 1909. The shipments of sphalerite concentrates were 2,608 tons smaller in quantity and $121,571 less in value. The shipments of carbonate of zinc concentrates declined from 453 tons to 280 tons, and the value was $5,655 less than in 1909.

The workable deposits of lead and zinc in Oklahoma, so far as known, are confined to two regions, one in the northeastern portion of the State, within the limits of Ottawa County, and the other in the Arbuckle Mountain region, all of the deposits of the latter region so far productive being located in Murray County.

NORTHEAST OKLAHOMA.

The lead and zinc mines of this section form the southwesternmost extension of the ore deposits of the Joplin region. They occur chiefly in chert breccias, but occasionally in limestone and sandstone breccias. The sandstones belong to the Chester group, the cherts to the Boone formation, and the limestones to either the one or the other, both being of lower Carboniferous age. The ores are galena, sphalerite, or zinc blende, and zinc carbonate and silicate. The galena is practically nonargentiferous, never containing as much as an ounce of silver to the ton of lead concentrates.

Peoria district.—The production at Peoria, the site of the first lead and zinc mining in Oklahoma, was very small in 1910, and so little development was inaugurated that little or no increase in output is probable in 1911.

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Quapaw district.—The mining companies of this district, for the most part operating on blanket ground carrying a low percentage of zinc, found the prevailing low ore price a serious problem. Many of the mills were in operation for only a portion of the year and development work was restricted. The closing down of some of the largest mills during the latter part of the year leaves the inference that the low-grade ore bodies in the blanket ground of this district were not commercially available at the ruling prices of zinc concentrates in 1910. The production of sphalerite concentrates was 1,094 tons less than in 1910. The mining situation at the close of the year, moreover, indicated a still lower output in 1911 unless higher ore prices prevail.

The Eastman Land & Development Co., having a plant capable of treating 250 tons of ore per shift, was the largest shipper of concentrates in the Quapaw district. The production of the Good Luck Mining Co. was only slightly less than that of the Eastman. The Good Luck was mining ore from two levels, one at 95 feet and the other at 120 feet.

The Omaha Petersburg Mining Co. operated its old 100-ton concentrating plant during a part of the year. In September the property was transferred to the Petersburg Land & Mining Co., which erected a new will with a capacity in excess of 400 tons daily. This mill is fully equipped, and power is furnished by a 250-horsepower gas engine. The production from the McAllister mine operated by E. T. Sweeney was only exceeded by that of two mines in the district. The Heap O'Brien Mining Co. was the largest seller of lead concentrates in the district and also produced quite a large quantity of sphalerite concentrates. Its concentrating plant has a capacity of 110 tons daily.

Other producing mines during 1910 were the Okla, the Sunburst, and the Cox leases (all on Baxter Royalty Co. land), the Ethel Miller, (formerly the Lancaster), the Big Jack, the Kansas City Quapaw, the Lucille, the Myrtle, the Mason, and the Ottawa.

Miami district.—The mines of the Miami district in 1910 shipped 3,364 tons of galena concentrates, valued at $174,134, and 10,055 tons of sphalerite concentrate, valued at $294,877. This shows a decrease of 692 tons of galena concentrates and of 1,514 tons of sphalerite concentrates when compared with the year 1909. The high ratio of concentrates to crude ore mined was maintained, and the large lead product recovered compensates in a measure for the high royalties paid and for the low selling price of sphalerite concentrates.

The ores are galena and sphalerite in about the proportion of one of the former to three of the latter, no oxidized ores having yet been found. The ores occur at a depth of 90 to 130 feet in sandstone breccias and in flint breccias lying below the sandstone. The sandstone is impregnated with a heavy oil, which, evaporating to asphalt, causes much trouble to save the concentrates, in that it balls up the ores on the jig beds and tends to float off the finer particles of ore. It also has a tendency to lower the grade of the concentrates by enveloping them in films of carbonaceous matter and so causing finely powdered marcasite and pyrite to stick to them.

The main ore body so far worked has the form of a long straight run, bearing about N. 30° W. and reaching from the Sunny Jim mine at the southeast to the Emma Gordon mine on the northwest, a dis-

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tance of 4,300 feet, and shown by the drill to extend at least 2,500 feet in a more northerly direction beyond the Emma Gordon mine, a total known length of about 1¼ miles. Throughout this distance the ore body is in a sandstone breccia, with shale overlying. At places in the run stopes have been taken up in the underlying chert breccia. The width of the run varies from 75 to 150 feet and the height from 8 to 13 feet, ranging up to 25 feet where the lower stopes have been taken up. Several other ore bodies have been opened to the west of this run which have their elongation parallel to the run, but none of these as at present developed are at all comparable to the main run in extent.

It is interesting to note that the production of the companies operating on the main ore body was larger in 1910 than in 1909, although the output of the district as a whole was about one-fifth less than in 1909.

The Emma Gordon Mining Co. was again much the largest producer in Oklahoma. The Standifer Mining Co. operated the mine and mill under lease. A run of ore about 86 feet wide and 18 feet high was being worked through 4 shafts, to the 135-foot level. In addition to the 400-ton mill operated by the Standifer Mining Co., a tailing mill (completed early in 1910) was operated by the High Five Mining Co.

The Turkey Fat Mining Co., on Miami Royalty Co. land, was the next largest producer in the Miami district. All ore was hoisted through 1 shaft 122 feet deep and treated in a 150-ton mill. The company also started sinking a 335-foot shaft 6 by 10 feet on the NW. ¼ sec. 6, T. 28, R. 43.

The other operating companies on the Miami Royalty Co. leasehold making a good production in 1910 were the Miami Amalgamated Mining Co. (Sullivan lease), the Old Chief Mining Co., the King Jack Mining Co., the Index Mining Co., the Wauhillau Mining Co., the Jennie May Mining Co., and the Lucky Strike Mining Co. The Buckeye lease on the Miami Royalty Co. was subleased to the Queen City Joplin Mining Co. and its 150-ton mill was in operation during the first six months of the year.

On Baxter Royalty Co. leases production was made by the following operators during 1910: Consolidated Mining Co., Golden Hen Mining Co., Miami Yankee Mining Co. (Crescent), Okmulgee Mining Co., Southern Queen Mining Co., and Willow Branch Mining Co.

The decision of the Circuit Court of Appeals in the actions instituted by the Attorney General of the United States involving the title to the fee or leasehold of lands disposed of by Indian allottees is anxiously awaited by many interested operators. Pending this decision, capitalists hesitate to make any large investments in developing lands, the title to which may be questioned.

ARBUCKLE MOUNTAIN REGION.

In the southern part of Oklahoma prospecting for lead and zinc has been prosecuted in the neighborhood of Ravia, at the southeast end of the Arbuckle Mountains, and in Murray County, 8 miles southwest of Davis near the northwest end of the same range, the last-mentioned locality having become productive in 1909. The Arbuckle Mountains consist of a core of pre-Cambrian granites and diabases

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overlain by the Reagan sandstone, a basal conglomerate formation of Upper Cambrian age, and that in turn by the Arbuckle limestone, of Cambrian and Ordovician age, followed by the other formations exhibited by the Paleozoic in that province. The whole uplift is greatly faulted and, especially in the mining district southwest of Davis, is sharply folded. The ore deposits in the Davis area are found in the dolomitic Arbuckle limestone, generally in clay-filled solution channels. All the ore so far shipped has been zinc carbonate from open pits and very shallow shafts. A few shafts are reported to reach a depth of 40 and 60 feet and to have developed deposits of zinc blende.

Three companies report small shipments of ore in 1910, and the total sales were only 67 tons in excess of those made in 1909, but development was active. The largest producers were lessees of lands of C. L. McGuire & Co. Ore was also shipped by the Hope-Sober Mining Co., and by the Arbuckle Mining & Milling Co.

WISCONSIN.

By J. P. DUNLOP.

PRODUCTION.

The production of lead and zinc in Wisconsin in 1910 is shown in the following table:

Production of lead and zinc in 1910, by districts, in short tons.[a]

District.	Ore.						Metal content.			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
	Galena.		Sphalerite.		Carbonate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Benton	625	$35,385	22,117	$407,855	40	$600	496	$43,648	5,856	$632,448
Cuba City-Elmo	1,844	97,253	6,312	171,502	.....	.....	1,489	131,032	2,167	234,036
Dodgeville	8	241	498	13,001	15	308	6	528	218	23,544
Hazel Green	243	11,061	13,047	215,194	.....	.....	176	15,488	3,238	349,704
Highland	630	30,731	1,116	34,488	5,148	67,450	497	43,736	1,801	194,508
Linden	328	16,871	4,727	85,784	.....	.....	261	22,968	1,222	131,976
Livingstone	296	13,646	10,590	200,754	.....	.....	213	18,744	2,843	307,044
Mifflin	263	14,452	5,712	157,485	.....	.....	211	18,568	2,061	224,748
Mineral Point	187	8,983	2,156	36,089	66	1,200	150	13,200	649	70,092
Montfort	340	17,748	1,431	25,360	.....	.....	272	23,936	391	42,228
Platteville	299	14,152	20,471	384,120	.....	.....	225	19,800	5,168	558,144
Shullsburg	555	25,970	1,055	18,942	.....	.....	417	36,696	293	31,644
State, total:										
1910	5,608	286,493	89,232	1,750,574	5,269	69,588	4,413	388,344	25,927	2,800,116
1909	4,659	254,514	65,421	1,505,752	5,130	63,603	3,694	317,684	23,152	2,500,416
1908	5,246	277,334	48,155	998,734	3,206	36,579	4,138	347,592	18,206	1,711,364

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer and that the value of the metal is calculated from the average daily quotations at New York and St. Louis.

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Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1909–10.

		1909	1910
Total crude ore	short tons	696,389	1,032,052
Total concentrates in crude ore	per cent	10.8	9.7
Lead	do	.7	.5
Zinc	do	10.1	9.2
Metal content	do	4.3	3.6
Lead	do	.5	.4
Zinc	do	3.8	3.2
Average lead content of lead concentrates	do	79.3	78.7
Average zinc content of sphalerite concentrates	do	37.6	34.8
Average zinc content of zinc carbonate concentrates	do	33.8	29.9
Average value per ton of lead concentrates		$54.63	$51.09
Average value per ton of sphalerite concentrates		$23.02	$19.62
Average value per ton of zinc carbonate concentrates		$12.40	$13.21

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette counties, and comprise the most important part of the ore deposits of the upper Mississippi Valley region. The ore deposits occur in the Galena dolomite and in the upper part of the Platteville limestone, both of Ordovician age. The ores are galena, sphalerite or zinc blende, and smithsonite or zinc carbonate, the latter locally known as "dry bone." As a lead region the district has been known from the earliest settlement days. In time the building of smelters near by made a market for the zinc ores. The first zinc ore to be mined was the carbonate found in association with lead in the shallow workings above ground-water level. When all the main deposits were worked out down to water level, there was a lull in mining in the region. Though the carbonate was known to give place to zinc blende and the lead to continue on below water, it was not deemed profitable to mine when continued pumping was necessary. About 8 or 10 years ago the higher price of zinc led to the opening of some of the deposits below water level, since which time zinc mining has increased until Wisconsin in 1908 and 1909 stood fourth in rank among zinc-producing States. The ore bodies are found in perpendicular, horizontal, or inclined cavities known as "openings" or "crevices," "flats," and "pitches." These openings sometimes extend for considerable distance in a straight line called a "range," and may be operated at different places by different companies. When a range is once established, it becomes an important guide in prospecting.

The galena of the district is nonargentiferous, and so far as known the zinc ores are free from cadmium. In some of the mines marcasite is so plentiful that the zinc blende concentrates are reduced to a very low grade. Owing to their nearness in specific gravity, marcasite and blende are very difficult to separate cleanly by hydraulic methods. Both electrostatic and electro-magnetic separation processes are in operation.

A small number of the concentrating plants in the district are equipped with roasters and magnetic separators. Some mining companies having such equipment did not operate it, and many of the companies constructing milling plants in 1910 did not report the erection of roasters. It is believed by many mine owners that it is more economical to sell the green concentrates than to invest in a roasting plant, entailing the employment of extra shifts of men during the entire day of 24 hours. The Joplin Separating Co. at Galena

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makes a business of separating low-grade blende-marcasite ores, and the Mineral Point Zinc Co. operates a roaster and magnetic separator at Mineral Point. The Campbell Separating Co., of Benton, and the Joplin Separating Co., of Joplin, Mo., also purchased green concentrates for treatment.

The concentrates, after being dried, are roasted, the customary form of roaster being a long, slowly revolving cylinder lined with firebrick. The roasting is carried far enough to render the marcasite magnetic, but not to drive off all the sulphur, after which the concentrates are passed under the magnetic separator and the iron is removed. The American Zinc Ore Separating Co. operates an electrostatic separator at Platteville. It is equipped with driers and both Blake-Morscher and Huff electrostatic separating machines. In this system of separation the expense and attendant losses of roasting are obviated, and the separated marcasite finds a market at about $4 per ton. Starting with a capacity of 75 tons daily, it has since been increased to 100 tons daily output. The multiplication of individual and custom roasters, by raising the low-grade ores to high grade, will have a tendency to reduce relatively the tonnage of zinc concentrates, though, of course, the metal content and the value will be less affected; hence these must serve as the basis of comparison for different years.

Slightly more than 50 per cent of the sphalerite concentrates shipped in 1910 went to the separating companies. The quantity of roasted concentrates sold by the mining companies was small when compared with the aggregate shipments. Some high-grade green concentrates were produced, but in general the tenor of the sphalerite concentrates sold was lower than in 1909. The average zinc content of the sphalerite concentrates sold in 1909 was 37.6 per cent and the average price per ton was $23.02; the corresponding content and price for 1910 was 34.8 per cent and $19.50.

Milling practice is much as in the Joplin region, except that in Wisconsin everything is on a smaller scale. The mills of 100 tons or over, with rougher, cleaner, sand jigs, and concentrating tables, have generally been built in the last few years. There were about 50 new concentrating plants erected in 1907, many of them being of the larger size. Mill construction was naturally much less active in the following years, there being only 15 mills built in 1908 and 20 (including second-hand mills moved to new locations) in 1909. The mills built in 1910, with their reported capacity and location, were the following: Schreier Zinc Co., 75 tons; Minnie Mining Co., 100 tons; Winskill Mining Co., 100 tons, and Lucky Twelve Mining Co., 200 tons, at Benton; New Year Lead & Zinc Co., 25 tons, at Cuba City; the Wallace Mining Co., 75 tons, at Highland; the Cleveland-Victory Mining Co., 50 tons, at Platteville; the Hinkle Mining Co., 100 tons, at Linden.

The crude ore yields from 5 to 20 per cent or more of zinc concentrates, and the building contracts in the case of the larger mills generally call for a saving of 85 per cent of the blende in the crude ore, but very likely in practice this figure is not often attained. The mining methods are largely determined by the mode of occurrence of the ores, but otherwise are similar to those in vogue in working the pockety ores at Joplin.

The zinc carbonate ore, which is mined principally in the Highland district, is chiefly taken by the Mineral Point Zinc Co. and made into

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zinc oxide in the plant at Mineral Point, Wis. A considerable quantity of the low-grade zinc blende concentrate is used in the same way.

The 1910 shipments of both lead and zinc concentrates from Wisconsin showed an increase over those for 1909. Although the average metal content of the concentrates was less than in 1909 and the price received for galena concentrates was $3.58 and for sphalerite concentrates $3.52 per ton less than in 1909, the total value of the ores increased $299,700. Galena shipments were larger by 949 tons in quantity and by $31,979 in value than in 1909. The combined Cuba City and Elmo district contributed nearly one-third of the production and the Benton, Highland, and Shullsburg districts each about one-ninth of the total. The sale of sphalerite concentrates was 23,811 tons larger than that in 1909, and the value increased $244,822. Benton district reported the sale of 22,117 tons, Platteville of 20,471 tons, Hazel Green of 13,047 tons, Livingston of 10,590 tons. The output of zinc carbonate concentrates was only 139 tons greater than in 1909, but the value, owing to a slightly increased price, was $5,985 larger. The mines of the Highland district contributed 97 per cent of the production. The total estimated crude ore, treated at the mills, increased from 696,389 tons to 1,032,052 tons, but the total concentrates in crude ore declined from 10.8 per cent to 9.7 per cent and the metal contents of the concentrates declined from 4.3 per cent to 3.6 per cent. Briefly summarized, the crude ore or "dirt" was only 75 per cent as rich as that treated in 1909. A larger quantity than usual of low-grade ore was mined, while some mines having rich "dirt" crowded their mills, losing considerably in the tailings but increasing their output. The separating companies were active competitors for low-grade concentrates, which stimulated their production.

The area of mining territory was not extended, most of the development being done on old properties. An increasing portion of the ore was mined by the larger corporations which can operate more economically and which require the ore to supply smelter, oxide, or acid plants owned by themselves or their affiliated interests.

REVIEW BY DISTRICTS.

Benton district.—The Frontier Mining Co. was the largest shipper of zinc concentrates in this district in 1910. The ore treated in its 75-ton mill was hoisted from 2 shafts each 190 feet in depth, and a shaft was started on the Sedgewick land after prospecting with a churn drill had disclosed a good run of ore. The Wisconsin Zinc Co. was the next largest shipper. This company operated the Drum and Winskill mines, the last named being purchased early in the year and fully equipped. Negotiations by the Vinegar Hill Zinc Co. for the purchase of the Wilkinson mine, which produced a good quantity of lead and some zinc in 1910, were in progress. The Field Mining & Milling Co. was not only a large shipper of zinc concentrates, but produced more lead concentrates than any other mine in the district. The company thoroughly prospected the William Crawhall tract preparatory to shaft sinking.

The Fox mine, which is equipped with a 100-ton mill, passed into the control of the Mineral Point Zinc Co., which expended consider-

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able money in improving the machinery and the underground workings. Some concentrates were shipped during the last half of the year. In the Ollie Belle mine, which is east of Benton and under the same control, electric power was substituted for steam and a steady production was maintained. The Lucky Twelve Mining Co., located on the Murphy land, constructed a new mill having a capacity of 200 tons in 12 hours, and was one of the largest producers in the district after the mill was put in operation.

Other producing properties in 1910 were the Sheffer Mining Co., leasing the Pittsburg-Benton mine; the Etna Mining Co., the Jack of Diamonds Mining Co., the Little Bennie Mining Co., the Minnie Mining Co., the Reich Mining Co., the Timmons Mining Co., and the White Church Mining Co. The Schreier Zinc Co., a nonproducer in 1910, completed a new concentrating plant and will ship in 1911.

Cuba City and Elmo districts—The Board of Trade Mining Co. was the largest shipper of lead concentrates in Wisconsin and also the largest seller of zinc concentrates in the Cuba City district in 1910. The Dall Lead & Zinc Co., which operates a 100-ton mill and a 25-ton roaster, was a large seller of high-grade concentrates. The Baxter Mining Co. property was only in operation for five months. The mill reservoir broke through and the flooding of the mine caused a cave-in, which destroyed the boiler room.

The Peaceful Valley Mining Co. sold a large quantity of low-grade concentrates. The Henrietta Mining Co. made a large production of lead but none of zinc.

Other shippers in the district in 1910 were the Jarrett Lead & Zinc Mining Co., the Midway Mining Co., the New Year Lead & Zinc Co., the Vanderventer Lead & Zinc Mining Co., and the Knox Mining Co., which operated the old Roosevelt mine.

The only producer in the Elmo district was the Beloit Elmo Mining Co., and most of its output was lead ore.

Dodgeville district.—Very little development was made in the Dodgeville district, and the output showed no increase. The equipments of the Snowball and the Rising Sun mines were sold and removed. The McKinley Mining Co. made a small production, but went out of business during the year, and the Curry and Badger properties were idle. Ore sales were made by Evans Bros., Carroll Guthrie, McKinley Bros., Roberts, Metcalf & Cretney, Wilcox Bros., and Harney, Bengeley & Davey.

Hazel Green district.—The most important mines in the district and the largest shippers were the Kennedy and the Hoskins mines, owned by the Mineral Point Zinc Co., which are both fully equipped with 100-ton concentrating plants operated by electric power furnished by the Interstate Light & Power Co. Formerly one of the plants used steam power and the other gasoline. The only other large producer was the Mills mine operated by the Wisconsin Zinc Mining Co., which has an electrically operated 250-ton concentrating plant supplied with ore by means of 2 shafts 206 feet in depth. The Big Dad 40-ton mill, which was rented to the Badger Mining Co., was in operation for a short time. A small tonnage of galena concentrates, sold by H. Pedelty, was recovered from the Crawford Mining Co. land. The Cleveland Mining Co. developed the Witherbee land and constructed a 150-ton electrically driven mill, which will be in operation in 1911.

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Highland district.—The larger part of the concentrates produced in the Highland district in 1910 were zinc carbonate concentrates from the Highland and the Franklin mines, which were shipped to the Mineral Point Zinc Co., which holds a half interest in the mines. The only extensive shipper of sphalerite concentrates was the Wallace Mining Co., which completed a 75-ton mill in August, 1910.

Shipments of smaller quantities of both lead and zinc concentrates were made by the following companies: Burrichter Mining Co., E. T. Goldthorpe & Co., Frank Kroll Mining Co., Lampe & Steppler, Kruel Mining Co., John Manning Mining Co., Minter Mining Co., St. Anthony Mining Co., Shaffra & Girman, Whelan Bros., and V. P. Steil.

Linden district.—The production from the Linden district was nearly 1,300 tons larger than it was in 1909. Ross Bros. were the largest producers of lead and of zinc concentrates. The ore was all hoisted through one shaft, which is 105 feet deep; their milling plant has a capacity of 60 tons. The Optimo Mining Co., with a 40-ton mill, was the next largest producer. The Hinkle Mining Co. equipped the old Robart mine with a concentrating plant having a capacity of 100 tons per day, which made a good production during the latter part of the year.

The other shippers of concentrates in 1910 were the Glanville Mining Co., the Rajah Mining & Milling Co., and Stephens Bros.

Livingston district.—The shipments of sphalerite concentrates from this district were over 3,000 tons in excess of those made in 1909. The Coker mine, owned by the Mineral Point Zinc Co., was the largest producer. Two shafts 105 feet and 100 feet deep, respectively, were used to send up the ore, and the concentrator was run double shift. The Ellsworth mine belonging to the Vinegar Hill Zinc Co., and equipped with a 100-ton concentrating plant yielded a large quantity of medium grade concentrates. The Sunrise Mining Co. was reorganized, the plant was overhauled, and a large quantity of concentrates was shipped.

Other shippers were the Washburn Mining Co. and White & Tregear.

Mifflin district.—The Grunow Mining Co., the Peni Mining Co., the Slack Mining Co., the B. M. & B. Mining Co., (old Squirrel mine), and the Peacock Mining Co., were the large producers of zinc blende in the Mifflin district. Smaller outputs were reported by the Dietzman Mining Co., and by Cushman & Nolan. All of the concentrates produced by the Slack Co. were not sold in 1910. The concentrating plants range in capacity from 40 tons to 75 tons and the shafts in the mines are from 70 to 100 feet in depth.

Mineral Point.—Shipments from this district increased over those for 1909. Active mining was confined to the mines of the Tripoli Mining Co., the Merry Christmas Lead & Zinc Mining Co., and the John Ross Mining Co. The Tripoli was much the largest producer and toward the end of the year showed every indication of increasing its output in 1911. The Merry Christmas mine, equipped with a 40-ton mill, was worked through a tunnel.

Montfort district.—The Montfort district increased its production of lead concentrates by 250 tons and of zinc concentrates by 1,100 tons over that of 1909. The only large producer was the O. P. David

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Mining Co., whose property is in Eden Township, Iowa County. The mine is opened by 2 shafts 127 feet deep, and the mill has a capacity of 50 tons per 10-hour shift. An interesting feature of this company's operations is that their underground workings are insured against loss by fire. Other companies doing development near Montfort in 1910 were the United Mining, Constructing & Manufacturing Co., and the Madison Mining & Development Co., which took over he old Red Jacket mine.

Platteville district.—The mines of the Platteville district were on the whole more active than in 1909 and the production of sphalerite concentrates increased about 2,000 tons. The zinc content of the sphalerite shipped ranged from 15 to 60 per cent, and over three-fourths of the concentrates sold assayed 30 per cent or less.

The Empire mine of the Wisconsin Zinc Co. was operated steadily and was by far the largest producer in the district or in the State. The old Hodge mine was operated by the Forcite Mining Co. until August, 1910, when it was taken over by the Mound City Mining Co. The output was large. Julius I. Wile operated the Lyght mine and shipped a large quantity of very low grade ore. The Homestead Mining Co. shipped some high-grade concentrates before their mill was burned. A new mill was quickly erected and the mine was again operating at the close of the year.

Other large shippers in 1910 were the Big Four Mining Co. (Trego mine), the Kohinoor-Blende Mining Co., the Klar Piquette Mining Co., the Platteville Lead & Zinc Co. (Enterprise mine), the St. Rose Mining Co., and the Cruson Mining Co. The Cleveland-Victory Lead & Zinc Co.'s new mill, in which dry concentration of the ores will be a feature, was not completed in 1910.

Shullsburg district.—Although there were only three mines in the Shullsburg district that reported sales of ore in 1910, the shipments of galena concentrates increased from 98 tons to 555 tons and those of sphalerite from 401 tons to 1,055 tons. The Rodham Mining Co., which operates a concentrating plant having a capacity of 25 tons in 8 hours, was the largest shipper. The Iron River Leasing Co. leased the mine and the 50-ton mill of the Brown-Croft Mining Co. and produced some lead and zinc concentrates. E. D. Meloy shipped galena only from the Climax mine.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES IN 1910.

(MINE PRODUCTION.)

By H. D. McCaskey.

INTRODUCTION.

This report is a brief review of the gold, silver, copper, lead, and zinc mining industries of the Eastern or Appalachian States for the calendar year 1910. The area covered is for the greater part coincident with the broad belt of old metamorphic and associated igneous rocks extending southwestward from Canada to Alabama. The zinc-lead belt of southwest Virginia and eastern Tennessee, however, whose rocks are mainly Cambrian and Ordovician limestone and dolomite, lies to the west of this great metamorphic belt.

References were given in the report for 1908 to the most important papers on these mines in the Eastern States, and the geologic relations were briefly described, and this matter will not be repeated here. Copies of that report still remain available for distribution.

In addition to the gold, copper, lead, and zinc mines, which form the main consideration of this report, one iron mine and several pyrite mines, whose ores furnish gold, silver, and copper as by-products, are taken into account; and the tonnages of such mines, for the purpose of this report, are those producing chalcopyrite or cupriferous pyrite, as near as this production can be ascertained.

The figures for production here set forth are based on confidential individual reports by mine operators to the Survey, and may differ in detail from those reported for the same period by smelters, refiners, and the United States Mint. The three last-named sources report the actual production in marketable form of metals treated during the year which may represent in part ore mined during the previous year; whereas the mine figures aim to give the metal recovery from the ore mined and sold or treated during the year in review. For a given series of years the mine and the smelter-refinery-mint figures should closely agree, and for any individual year the lag at the close of the year is usually small, being largely compensated for by a corresponding overlap at the beginning of that year.

The cooperation of mine operators and others of the mining industry with the United States Geological Survey has continued to be most cordial and is here gratefully acknowledged.

PRODUCTION.

The total value of the mine output of gold, silver, copper, lead, and zinc for the calendar year 1910 was $10,127,304. This represents the production of 100 mines, of which 61 were gold placer mines,

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many of them small. The total gold output from all mines was 8,974.63 fine ounces, valued at $185,522, and the silver production—recovered entirely in the refining of the gold and copper produced, as there are no silver ores worked in the Eastern States—was 91,595 fine ounces, valued at $49,461.

There were 1,524.54 fine ounces of gold and 149 fine ounces of silver obtained in 1910 from placer workings; 6,977.57 ounces of gold and 1,001 ounces of silver were recovered from gold-quartz ores; and 472.52 ounces of gold and 90,445 ounces of silver were derived from copper ores. The small lead production of Virginia was not productive of precious metals, and the zinc ores of the Eastern States do not contribute to the gold and silver supply.

The copper production, from copper and iron ores, was 17,923,412 pounds, valued at $2,276,273, a decrease of 2,430,813 pounds in quantity and of $369,766 in value, as compared with the production of 1909. The lead production in 1910, all from lead-zinc ore, was 198,850 pounds, valued at $8,750. There was no mine production of lead reported for 1909. The zinc output in the Eastern States in 1910 was 140,875,886 pounds, figured as spelter, valued at $7,607,298, a decrease from the production reported for 1909 of 25,452,973 pounds in quantity and of $1,374,460 in value.

There were 60,410 short tons of dry and siliceous ores mined in 1910, with an average gold and silver value per ton of $2.39, as against 25,531 tons in 1909 with a value of $4.33. There were 774,040 short tons of copper ore mined with an average precious metal value per ton of $0.076, as against 787,146 tons in 1909 with a gold and silver value of $0.06. In addition to precious metals, the copper ores produced an average of 23.2 pounds of copper per ton of ore in 1910, as against 25.9 pounds per ton in 1909. There was also in 1910 a production of an average of 31.1 pounds of lead per ton from 6,400 tons of lead ore. The output of zinc ore was 411,381 short tons in 1910, with an average recoverable content of 342.4 pounds of zinc per ton, against 510,172 tons in 1909 with an average zinc content of 326 pounds per ton.

The gold production of the Eastern States increased in value $29,582 in 1910, and the silver output increased by 24,683 ounces and $14,667 in value. The lead production increased by the entire output for 1910—198,850 pounds, valued at $8,750—as there was no production in 1909. The copper production decreased by 2,430,813 pounds and $369,766 in 1910, and the zinc output decreased by 25,452,973 pounds and $1,374,460.

The following is a condensed tabulated statement of the production of the Eastern States in 1909 and 1910:

Mine production of gold, silver, and associated metals in Eastern States in 1909 and 1910.

Years.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1909	7,543.60	$155,940	66,912	$34,794	20,354,225	$2,646,039
1910	8,974.63	185,522	91,595	49,461	17,923,412	2,276,273
Increase (+) or decrease (−)	+1,431.03	+29,582	+24,683	+14,667	−2,430,813	−369,766

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Mine production of gold, silver, and associated metals in Eastern States in 1909 and 1910—Continued.

Years.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1909			166,328,859	$8,961,758	$11,818,531
1910	198,850	$8,750	140,875,886	7,607,298	10,127,304
Increase (+) or decrease (−)...	+198,850	+8,750	−25,452,973	−1,374,460	−1,691,227

The total tonnage reported as producing the five metals—gold, silver, copper, lead, and zinc—from deep mines in 1910 was 1,252,231 short tons, yielding a total metal value of $10,095,709. This gives an average total recovered value in metal from deep mines of $8.06 per ton of ore for 1910; the corresponding value for 1909 was $8.91.

GOLD.

The production of gold in the Eastern States in 1910 was 8,974.63 fine ounces, valued at $185,522. [1] This shows an increase in value of the output over that of 1909 of $29,582. The most notable increases in 1910, over $27,000 in each case, were in the same two States in which there were marked decreases, over $40,000 in each case, in 1909—North Carolina and South Carolina. These changes were again mainly due to operations of the largest individual mines in each State. There was increased output of over $4,000 from Alabama also, but the remaining States showed smaller production of gold in 1910, the most important falling off being about $25,000 in Georgia. Of the gold output in 1910 the placers yielded 1,524.54 fine ounces, or 17 per cent, the quartz ores 6,977.57 fine ounces, or 78 per cent, and the copper ores, 472.52 fine ounces, or 5 per cent.

SILVER.

The production of silver in the Eastern States in 1910 was 91,595 fine ounces, valued at $49,461.[2] These figures show an increased output of silver over that of 1909 of 24,683 fine ounces and of $14,667 in value. This is especially interesting in view of the decreased copper production as indicating a considerable increase in recovery of silver per ton from refining of copper from its ores—the chief source of silver in the Appalachian States. As shown by the tables below, the quantity of silver recovered from refining the gold produced in the Eastern States is relatively small, and there is no other source for silver in these States, as silver ores are not mined and the lead and zinc ores are nonargentiferous. The silver recovered is mainly from copper produced at Ducktown, Tenn.

COPPER.

The copper production of the Eastern States in 1910 was 17,923,412 pounds, valued at $2,276,273,[3] a decrease from the production for

[1] The value of gold is $20.671834625323 per fine ounce.
[2] The Survey estimate for the average value of silver per fine ounce in 1910 is 54 cents. The figure for 1909 was 52 cents.
[3] The Survey figure for the average price of copper in 1910 is 12.7 cents per pound. The price for 1909 was 13 cents.

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1909 of 2,430,813 pounds in quantity and of $369,766 in value. The most important production was from the Ducktown district of Tennessee, which contributed 94 per cent of the output in 1909 and in 1910. The remainder of the production was from Pennsylvania, North Carolina, and New Hampshire in the order named.

LEAD.

The production of lead in the Eastern States in 1910 was 198,850 pounds, valued at $8,750,[1] and was all from Virginia. There was no output in 1909.

ZINC.

The total zinc production of the Eastern States in 1910, figured as spelter, was 140,875,886 pounds of metal, valued at $7,607,298.[2] These figures show a decrease from the output for 1909 of 25,452,973 pounds in quantity and of $1,374,460 in value. Of the zinc output of the Eastern States in 1910 over 97 per cent came from New Jersey, the remainder being produced in the lead-zinc belt of Virginia and Tennessee.

Mine production of gold and silver in Eastern States in 1910, by States, in fine ounces.

States.	Gold.		Silver.		Increase (+) or decrease (−) in value compared with 1909.	
	Quantity.	Value.	Quantity.	Value.	Gold.	Silver.
Alabama	1,622.16	$33,533	268	$145	+$4,294	+ $35
Georgia	1,722.25	35,602	335	181	−25,018	+ 76
Massachusetts, New Hampshire, and Pennsylvania	291.07	6,017	526	284	− 913	− 1,533
North Carolina	3,291.68	68,045	9,053	4,888	+27,815	+ 4,629
South Carolina	1,853.92	38,324	46	25	+27,271	+ 2
Tennessee	150.59	3,113	81,239	43,869	− 1,005	+13,898
Virginia	42.96	888	128	69	− 2,862	− 2,440
Total	8,974.63	185,522	91,595	49,461	.....	.....
Increase (+) or decrease (−) compared with 1909	+1,431.03	+ 29,582	+24,683	+14,667	+29,582	+14,667

Source of gold and silver in Eastern States in 1910, by States, in fine ounces.

States.	Gold.			Silver.		
	Placers.	Dry or siliceous ores.	Copper ores.	Placers.	Dry or siliceous ores.	Copper ores.
Alabama	17.27	1,604.89	.....	.....	268	.....
Georgia	880.96	841.29	.....	84	251	.....
New Hampshire and Pennsylvania	.....	.....	291.07	.....	.....	526
North Carolina	497.34	2,745.77	48.57	43	456	8,554
South Carolina	100.42	1,753.50	.....	20	26	.....
Tennessee	24.19	.....	126.40	2	.....	81,237
Virginia	4.36	32.12	6.48	.....	.....	128
Total	1,524.54	6,977.57	472.52	149	1,001	90,445

[1] The Survey figure for the average price of lead in 1910 is 4.4 cents per pound.
[2] The Survey average price for spelter in 1910 is 5.4 cents per pound. The price for 1909 was the same.

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Number of producing mines, ore production, and average value of gold and silver per ton in Eastern States in 1910, by States, in short tons.

States.	Number of mines.			Ore production from deep mines and average recovered value in gold and silver per short ton mined.								
					Dry or siliceous ores.		Copper ores.		Lead ores.[1]		Zinc ores.[1]	
	Placer.	Deep.	Total.	Total production.	Quantity.	Average value.	Quantity.	Average value.	Quantity.	Average value.	Quantity.	Average value.
Alabama	3	3	6	9,763	9,763	$3.41	.....	.....	.....	.....	.....	.....
Georgia	23	8	31	13,562	13,562	1.29	.....	.....	.....	.....	.....	.....
New Hampshire and Pennsylvania	....	2	2	218,752	.....	.....	218,752	$0.06	.....	.....	.....	.....
New Jersey	....	1	1	375,677	.....	.....	.....	.....	.....	.....	375,677	$0.0
North Carolina	23	13	36	14,914	12,693	4.42	2,221	2.51	.....	.....	.....	.....
South Carolina	10	2	12	24,153	24,153	1.50	.....	.....	.....	.....	.....	.....
Tennessee	1	4	5	578,434	.....	.....	552,796	.08	.....	.....	25,638	.0
Virginia	1	6	7	16,976	239	2.78	271	.75	6,400	$0.0	10,066	.0
Total	61	39	100	1,252,231	60,410	2.39	774,040	.076	6,400	.0	411,381	.0

[1] No recovery of gold or silver from zinc or lead ores.

Mine production of copper, lead, and zinc in Eastern States in 1910, by States, in pounds.

States.	Copper.		Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New Hampshire and Pennsylvania	939,769	$119,351	.....	.....	.....	.....
New Jersey	.....	.....	.....	.....	137,355,219	$7,417,182
North Carolina	140,514	17,845	.....	.....	.....	.....
Tennessee	16,837,727	2,138,391	.....	.....	1,932,555	104,358
Virginia	5,402	686	198,850	$8,750	1,588,112	85,758
Total	17,923,412	2,276,273	198,850	8,750	140,875,886	7,607,298
Increase (+) or decrease (−) compared with 1909	−2,490,813	−369,766	+198,850	+8,750	−25,452,973	−1,374,460

Number of copper and zinc producing mines, ore tonnage, and average pounds of metal recovered per short ton of ore in Eastern States in 1910, by States.

States.	Number of mines.		Copper ore.		Lead ore.		Zinc ore.	
	Copper.	Zinc.	Quantity.	Average per ton of ore.	Quantity.	Average per ton of ore.	Quantity.	Average per ton of ore.
New Hampshire and Pennsylvania	2	.....	218,752	4.3	.....	.....	.....	.....
New Jersey	.....	1	.....	.....	.....	.....	375,677	365.6
North Carolina	2	.....	2,221	63.2	.....	.....	.....	.....
Tennessee	2	2	552,796	30.5	.....	.....	25,638	75.4
Virginia	1	[1] 2	271	20.0	6,400	31.1	10,066	157.8
Total	7	5	774,040	23.2	6,400	31.1	411,381	342.4

[1] 1 lead-zinc.

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THE MINING INDUSTRY BY STATES.

ALABAMA.

The mine production of gold in Alabama in 1910 was 1,622.16 fine ounces, valued at $33,533, and that of silver was 268 fine ounces, valued at $145. These figures show an increase in value of gold output for Alabama of $4,294, and an increase in silver output of 56 fine ounces in quantity and of $35 in value. The silver production is entirely from recovery of this metal in refining the gold. No copper ores were mined in 1910.

The production of gold and silver in Alabama in 1910 was reported from 3 deep mines and 3 gold placers. The total placer gold, all from Mud and Clear creeks, in Cleburne County, was valued at $357 in 1910, as against $69 in 1909. The deep-mine production was from 9,763 short tons of ore, with an average recoverable value per ton in gold and silver of $3.41. In 1909 the ore production was 9,886 short tons, but the recoverable value per ton was only $2.96.

The output in 1910 was again almost wholly from the Hog Mountain mines in Tallapoosa County. The siliceous ores of this mine are in part oxidized and in part sulphides, and they are treated in a 120-ton cyanide plant. There was a nominal output of gold from the Gold Ridge mines in Randolph County, and development work at the Story prospect in Talladega County yielded a small amount of siliceous smelting ore which was shipped. Dump material was also treated at this property by amalgamation in a 5-stamp mill. Operations continued for only three months in 1910. Development work was done at the Holly mines near Dadeville in Tallapoosa County.

GEORGIA.

The production of gold in Georgia in 1910 was 1,722.25 fine ounces, valued at $35,602, and the production of silver was 335 fine ounces, valued at $181. Compared with the figures for 1909 the production of 1910 shows a decrease in gold output of $25,018, and a decrease in production of silver of 21 ounces, but an increase in value of $76. There was no production of copper or lead ore in Georgia in 1910.

The placer gold output was 880.96 fine ounces and the remaining production of gold, all from quartz ores, was 841.29 fine ounces. This shows a considerable increase of placer gold, but a much larger decrease of gold from the deep mines, owing mainly to the idleness of the Franklin mine in Cherokee County. The silver output from placer gold in 1910 was 84 fine ounces and from quartz gold 251 fine ounces. There were 13,562 short tons of siliceous gold ore mined in Georgia in 1910, with an average recoverable value of $1.29 per ton in gold and silver, against 8,549 tons in 1909 with an average extraction value of $5.18 per ton. There were 23 placer and 8 deep mines producing in 1910, against 15 placers and 14 deep mines in 1909. Placer mining has been on the increase in Georgia for the last two years, but deep mining in general has not kept pace.

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REVIEW BY COUNTIES.

Mine production of gold and silver in Georgia in 1910, by counties, in fine ounces.

Counties.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Cherokee	35.99	$744	2	$1
Dawson and Haralson	197.42	4,081	111	60
Hall	107.82	2,229	8	4
Lumpkin	528.21	10,919	41	22
McDuffie	357.49	7,390	68	37
Paulding	232.59	4,808	57	31
White	259.58	5,366	48	26
Other counties	3.15	65	.....	.....
Total	1,722.25	35,602	335	181

Carroll County.—There was no production of placer gold reported from near Villarica in Carroll County in 1910.

Cherokee County.—The production of Cherokee County in 1910 decreased to $744 in gold and 2 ounces of silver, due almost entirely to the closing down of the well-known Franklin mine in June, 1909. There was only a nominal production from the Worley and the Sixes mines.

Dawson County.—There was only a nominal output of placer gold from Taylor Creek, near Dawsonville, in Dawson County, in 1910.

Fannin County.—In Fannin County there was a small output of placer gold in 1910.

Hall County.—The production of Hall County in 1910 was $2,229 in placer gold and 8 ounces of silver, valued at $4. The Glade placer was the most important producer reported.

Haralson County.—In Haralson County the Royal mine made a considerable output of gold from crude ore and the working over of old tailings in 1910.

Lincoln County.—The Sale and Lamar, Paschal, Edmonds, and Seminole mines in Lincoln County were all reported idle in 1910. The last-named mine has been a producer of copper and lead and is equipped with a concentration mill, roasting furnace, and small blast furnace.

Lumpkin County.—The production of Lumpkin County was the most important in the State in 1910, amounting to $10,919 in gold, mainly from placers, and a nominal quantity of silver, as against $20,944 in gold in 1909. This county includes the Dahlonega and Auraria districts, which have been notable producers in the past, and which still support many small operations, largely placers. The Briar Patch, New Findley, Crown Mountain, Liberty Bell, Seawell, and Standard were among the producers reported in 1910.

McDuffie County.—In McDuffie County—the second largest producing county—there was an output of gold amounting to $7,390 in 1910, mainly from the Hamilton and Parks mines, near Thomson. There was also considerable development work done at the Columbia mine, which is opened by an incline shaft 450 feet deep. The ore at the Hamilton mine is reported to be free-milling gold quartz; and a stamp-milling, plate-amalgamation, and concentrating plant was in

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prospect for 1911. The vertical shaft is 100 feet deep. The Parks and Columbia mines are both equipped with stamp-milling, plate-amalgamating, and concentrating mills, and the ore in both is reported mainly free milling. The tailings of the Parks mine are cyanided. The Parks mine, the largest producer of gold in the State in 1910, was temporarily closed early in the year and work was concentrated upon the opening of the Columbia and the Hamilton mines under the same management. The Tatham mines were idle in 1910.

Paulding County.—In Paulding County in 1910 there was an output of $4,808 in gold and a nominal quantity of silver, chiefly from the Peerless or Harper-Johnson, Kilgore, and Glade-Pendley prospects. The Peerless property is equipped with a 10-stamp 50-ton mill, and Snodgrass washer, but the washer alone was operated in 1910.

White County.—In White County there was a production of $5,366 in gold and a small amount of silver, mainly from the Loud, Parks, Goula Hill, and Childs placers, near Cleveland. This county produced $3,501 in gold in 1909. The Loud mines were worked by the hydraulic method in 1910, under lease. These deposits have produced many fine specimens of crystalline gold.

MAINE.

There was no production of gold, silver, copper, lead, or zinc reported from Maine in 1910. The latest operations were at the Deer Isle mine, in Hancock County, but that property was reported closed in 1910.

MARYLAND.

There was no output of copper, gold, or silver reported from Maryland in 1910. At the New London copper mine, near Monrovia, in Frederick County, the shaft was retimbered and work was begun on the erection of a concentrating mill, including crusher, rolls, Richards pulsating jig, and James tables. A Sullivan compressor plant was completed.

MASSACHUSETTS.

No output of copper, lead, silver, or gold was reported from operations of mines in Massachusetts in 1910. A small quantity of copper is usually recovered as a by-product of pyrite ores, especially from the Davis pyrite mine, at Rowe, in Franklin County, but that mine was not worked in 1910, operations being confined to cleaning up the property.

NEW HAMPSHIRE.

In New Hampshire the only operations producing gold, silver, or copper were at the Milan mine, at West Milan, in Coos County, from which there was a small output of copper, silver, and gold as a by-product from pyritic ores. The mine was closed down the greater part of the year.

NEW JERSEY.

In New Jersey the well known Mine Hill zinc mines, at Franklin Furnace, in Sussex County, continued their important production of zinc throughout the year, sending 308,353 short tons to the concentrating mills (producing 263,606 short tons of concentrates) and

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67,324 short tons of crude ore to the smelters. Figured as metallic zinc, the total recoverable output was 137,355,219 pounds of spelter, a decrease of 27,664,852 pounds from the corresponding output in 1909. The mines are opened by a vertical shaft 965 feet deep, a slope to the 600-foot level, and a shaft 1,500 feet deep on an incline of 47½°. The crushing plant has a capacity of 2,240 short tons per 24 hours and the separator a capacity of 1,344 short tons.

In Warren County, across the Delaware from Stroudsburg, Pa., the Pahaquarry copper mine is developed by an open cut 508 feet above the river and by tunnels and is equipped with a 200-ton concentration plant, including a No. 5 Austin crusher, 2 sets of 11-inch by 42-inch rolls, 4 sets of 10-inch by 30-inch rolls, a triplex roll, 12 Overstrom tables, 4 Frue vanners, and equipment for the flotation process on fine ores. A small trial shipment of siliceous concentrates, reported to run 25 per cent in copper, was made in 1910. The ore occurs as impregnation of chalcocite in gray sandstone and is reported to average 3 per cent of copper from a large number of samples.

NEW YORK.

In Lewis County, N. Y., some experimenting was done in attempting to recover gold from black sands, but no production was reported for 1910. Some prospecting was done at the Phœnix lead-zinc mine, near Otisville, and a vein of ore was reported found at 350 feet from the tunnel mouth, the vein being drifted upon for 200 feet. At the Donovan mine, near Macomb, in St. Lawrence County, prospecting for lead ore was continued, and experimental runs of a 20-ton concentrating mill were made.

NORTH CAROLINA.

Mine production of gold, silver, and copper in North Carolina in 1909 and 1910.

Years.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1909	1,946.13	$40,230	499	$259	224,512	$29,186	$69,675
1910	3,291.68	68,045	9,053	4,888	140,514	17,845	90,778
Increase (+) or decrease (−)	+1,345.55	+27,815	+8,554	+4,629	−83,998	−11,341	+21,103

The production of gold in North Carolina in 1910 was 3,291.68 fine ounces, valued at $68,045, an increase over the output for 1909 of 1,345.55 fine ounces in quantity and of $27,815 in value. The yield of silver, recovered in refining the gold and copper produced, was 9,053 fine ounces, valued at $4,888, an increase of 8,554 ounces in quantity and of $4,629 in value. The copper production was 140,514 pounds, valued at $17,845, a decrease of 83,998 pounds and of $11,341. The total value of the production of gold, silver, and copper in North Carolina in 1910 was $90,778, an increase over the corresponding value for 1909 of $21,103. North Carolina regained first place among the Eastern States in 1910 in the production of gold.

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There were 23 placer mines in operation in North Carolina in 1910 and 13 deep mines, or 36 in all, as against 18 placer and 15 deep mines in 1909. The deep mines produced 14,914 short tons of ore in 1910, of which 12,693 tons were gold-quartz ores, with an average total recovered value in gold and silver of $4.42 per ton, and 2,221 tons were copper ores, with an average precious-metal value of $2.51 per ton, and yielding 63.2 pounds of copper per ton. In 1909 there were produced 3,696 tons of siliceous gold ores and 3,575 tons of copper ores. The placers of North Carolina yielded 497.34 fine ounces of gold and 43 fine ounces of silver in 1910; the siliceous ores produced 2,745.77 fine ounces of gold and 456 fine ounces of silver; and the copper ores yielded 48.57 fine ounces of gold and 8,554 fine ounces of silver. The notable production of silver from North Carolina in 1910 was, therefore, from copper ores. The average precious-metal extraction per ton of siliceous ore continued to decrease, being $8.88 in 1908, $5.07 in 1909, and $4.42 in 1910.

REVIEW BY COUNTIES.

Mine production of gold, silver, and copper in North Carolina in 1910, by counties.

Counties.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
Burke	139.85	$2,891	17	$9	.....	.....	$2,900
Cabarrus	44.17	913	6	3	.....	.....	916
Catawba and Gaston	142.22	2,940	66	36	.....	.....	2,976
Franklin and Nash	31.64	654	2	1	.....	.....	655
Macon and Polk	14.07	291	3	2	.....	.....	293
Mecklenburg and Union	209.90	4,339	71	38	.....	.....	4,377
McDowell	38.12	788	8	4	.....	.....	792
Montgomery and Randolph	2,425.57	50,141	421	227	.....	.....	50,368
Orange, Person, and Rowan	246.13	5,088	8,459	4,568	140,514	$17,845	27,501
Total	3,291.67	68,045	9,059	4,888	140,514	17,845	90,778

Burke County.—There was a production of $2,891 in gold in Burke County in 1910, as against $4,535 in 1909, and a nominal amount of silver. There were several placer operations near Bridgewater and Brindletown, among them the old Mills hydraulic mine where considerable attempts were made to mine on a large scale. Sluicing was only partially successful at this mine, even with extensive equipment, including a Canton Hughes pump, and 2,400 feet of 8-inch and 6-inch pipe through which water was raised 650 feet. The surface material covered hard rock to a slight depth and hydraulic mining failed. Attempts were then made to develop the Hedge and the White Bank mines, apparently with success.

Cabarrus County.—In Cabarrus County several small operations produced $913 in gold in 1910, as against $1,636 in 1909, the largest output being derived as usual, from reworking the dump of the old Phœnix or Miami mine.

Catawba County.—The Catawba or Shuford mine was successfully worked in open cuts for two months in 1910 by steam shovel, conveyors, and washers, and yielded considerable gold. The England mine also made a small output of gold.

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Cleveland County.—There was no production of gold in Cleveland County in 1910. This metal is recovered mostly in this county as a by-product in mining for monazite, but none was reported from this source for 1910.

Davidson County.—There was no production reported from Davidson County in 1910. The Cid mining district, including the Silver Hill, Silver Valley, Welborn, Conrad Hill, Peters, Emmons, Cid, and other mines, was described by Pogue [1] in 1910.

Franklin County.—In Franklin County the Portis mine produced a small amount of surface gold in 1910.

Gaston County.—A small production of gold was reported in Gaston County in 1910, principally from the Kings Mountain and the Burrell-Wells mines. The former yields a small production annually, largely from reworking the old dump; and the latter was only operated in the first part of 1910, later being closed and its machinery sold. The equipment included a 10-stamp mill with concentrators, and the ore was crushed, amalgamated, and concentrated, the concentrates being shipped.

Granville County.—In Granville County the Blue Wing and Copper King mines of the Virgilina copper belt were both idle in 1910, and there was no production of metals reported. The Blue Wing mine supplied siliceous copper ore to the Ducktown smelters in 1909.

Jackson County.—There was no production of copper, silver, and gold reported from the Cullowhee mine in Jackson County in 1910, although the small copper furnace on this property produced some matte in 1909.

Macon and McDowell Counties.—Small outputs of placer gold were reported from near Flats in Macon County, and near Marion in McDowell County in 1910.

Mecklenburg County.—In Mecklenburg County the Catawba River dredge, near Charlotte, produced a small amount of placer gold in 1910. The Surface Hill mine, under new ownership, was in prospect of being worked by the hydraulic method.

Montgomery County.—In Montgomery County the Iola mine, near Candor, the most important gold producer in the State of recent years, made a considerable output in 1910. The plant was run on half time from May 1 to December 14, when it was destroyed by fire. The mine is opened by a 650-foot vertical shaft and a 450-foot incline shaft, and the plant included a 50-ton Lehigh-Fuller mill and cyanide equipment with Oliver filter. Production was also reported from the Old Coggin and the Golconda mines. The Old Coggin mine, after standing full of water for 28 years, was unwatered in 1910. The shaft was retimbered and a small amount of crosscutting and drifting was done during the last two months of the year. The plant included a 10-foot 40-ton Chilian mill, and additional equipment was in prospect for 1911.

Nash County.—In Nash County the Mann-Arrington mine yielded a nominal output of gold in 1910. The Braswell, Nelms, Williams, Strickland, Griffin, and other prospects, near Nashville, were reported to show gold and copper ores which promised well. These are all new finds on farming land not far from the Portis mine and may prove of considerable interest if developed.

[1] Pogue, J. E., Cid mining district of Davidson County, N. C.; Bull. North Carolina Geol. and Econ. Survey No. 22, Raleigh, 1910.

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Orange County.—The North State or Robertson mine made a small output of placer gold in 1910, but was closed down the greater part of the year pending reorganization of controlling interests.

Person County.—In Person County the Durgy mine of the Virgilina belt supplied siliceous copper ore yielding copper and silver to the Ducktown (Tenn.) smelters in 1910, furnishing the greater portion of the silver and copper output of the State. The Duke mine was being prospected in 1910.

Polk County.—The Double Branch gold mine, in Polk County, was actively developed in 1910. The mine is opened by five shafts and is equipped with one 10-stamp mill and one 3-stamp mill, both being equipped with plates and concentrating tables.

Randolph County.—In Randolph County prospecting on the Scarlett mine, near Ashboro, yielded a nominal output of gold, and the Talbert property also produced on a small scale. The Ashboro mine was operated for a short time and development was made with reference to future placer and deep mining. On the Southern Homestake property prospecting for low-grade free-milling gold in schists was also carried on.

Rowan County.—The mines at Gold Hill, in Rowan County, made but a nominal output in 1910, mainly from tributing on old dumps. Preparations were being made to unwater the 850-foot Randolph shaft of the Gold Hill property. At the Union copper mines the No. 12 shaft, which develops a gold vein with traces of copper, was sunk 100 feet to the 400-foot level, a gold vein was opened up on the 230-foot level, and mill tests were made of the ore. From No. 7 shaft, which develops a copper vein with traces of gold, a sample shipment of ore was made. The various other mines at Gold Hill were inactive. The Steele placer, near Cleveland, was a producer of gold in 1910.

The ore deposits and mines of the Gold Hill district have recently been described by Laney.[1]

Union County.—The Bonnie Doon mine, in Union County, near Indian Trail, made a considerable output in 1910. This property is opened by a 170-foot shaft, and ore was stoped in 1910 from both 120-foot and 170-foot levels. A considerable quantity of old dump material has also lately been sent through the mill. The plant includes a 10-foot slow-speed Lane mill, built in 1910, and provision is made for both amalgamation and concentration. The ores are both oxidized and sulphide. Since December, 1910, the mine has been operated under lease.

PENNSYLVANIA.

Adams County.—There was considerable activity in development of copper mines in the pre-Cambrian rhyolite and greenstone schist near Charmian in Adams County in 1910. These mines have been briefly described by Stose.[2]

At the Bingham mine development is by an open cut. At the Eagle mine both gold and copper ore are reported, both at the surface and cut by diamond drills in depth. Beneath the gossan on the copper deposits gold is said to be visible in the ore. The company operating both the Bingham and the Eagle properties had in prospect

[1] Laney, F. B., The Gold Hill mining district, North Carolina: Bull. North Carolina Geol. and Econ. Survey No. 21, Raleigh, 1910.

[2] Stose, George W., The copper deposits of South Mountain in southern Pennsylvania: Bull. U. S. Geol. Survey No. 430, 1910, p. 122.

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the erection of a 150-ton copper furnace. At the Eagle Metallic mine development is by a 480-foot vertical shaft and a 300-foot tunnel. A diamond core drill was reported to have been in ore for several hundred feet. A 175-ton Allis-Chalmers copper furnace was in course of erection in 1910. Oxidized ore is said to extend down for 400 feet in this deposit. The Virgin mine was also in active development in 1910.

Lebanon County.—An increased production of copper was reported in 1910 from the cupriferous pyrite saved as concentrates in magnetic separation of ore from the Cornwall iron mine in Lebanon County. The mine is worked by open cut, and the plant includes a 500-ton concentrator, operated by the Gröndal process providing for crushing, magnetic separation, concentration by Wilfley tables and vanners, and briquetting of the concentrates. The product is sold to copper smelters. The ore is copper sulphide in a basic gangue and carries a little cobalt.

SOUTH CAROLINA.

The mine production of gold in South Carolina in 1910 was 1,853.92 fine ounces, valued at $38,324, an increase in value over the output of 1909 of $27,271. The silver production was 182 fine ounces, valued at $97, in 1909, and 46 ounces, valued at $25, in 1910. There was a small output of copper reported from South Carolina in 1909, but none in 1910. The value of the total production in South Carolina in 1910 was $38,349, as against $11,076 in 1909.

The yield of gold and silver reported from South Carolina in 1910 was from 10 placers and 2 deep mines. In 1909 there were 6 placers and 5 deep mines. The total quantity of ore reported from the deep mines in 1910 was 24,153 short tons, all of siliceous gold ore, with an average recoverable value of $1.50 per ton. In 1909, 3,150 short tons of siliceous gold ore was reported with an average extraction value of $3.06 per ton. The placers yielded 100.42 fine ounces of gold in South Carolina, and the remainder of the production, 1,753.50 fine ounces, was from deep mines.

REVIEW BY COUNTIES.

Abbeville County.—In Abbeville County prospecting only was reported from the Saluda copper mine near Donalds in 1910. Two small placers made a nominal output of gold.

Cherokee and Chesterfield counties.—Small placer operations near Gaffney in Cherokee County and Jefferson in Chesterfield County made a nominal output of gold in 1910.

Lancaster County.—In Lancaster County the well-known Haile mine, near Kershaw, made an important output of gold. The mine work done in 1910 was all in open cut. The low-grade gold ore of this mine is treated in a 60-ton mill, in which ore is crushed with stamps to pass through 35-mesh and concentrated, and the concentrates are chlorinated by the Thies process. The Haile mine was first worked in 1829 and has been operated almost continuously for the last 30 years.

Spartanburg County.—In Spartanburg County there was a small output of placer gold, but the deep mines were inactive in 1910.

Union County.—There was a nominal production of placer gold in Union County in 1910.

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York County.—In York County there was a small output of gold from smelting ore shipped from the Darwin mine, near Smyrna, in 1910. The product of the mine is a gold-silver-copper sulphide ore, and the property is developed by a short tunnel and a 76-foot shaft. Increased work at this mine was in prospect for 1911. Development work only was reported at the Wolf Creek, Rose, and Love properties.

TENNESSEE.

Mine production of gold, silver, copper, and zinc in Tennessee in 1909 and 1910.

Years.	Gold.		Silver.		Copper.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1909	199.21	$4,118	57,637	$29,971	19,206,806	$2,496,885	1,192,161	$64,376	$2,595,350
1910	150.59	3,113	81,239	43,869	16,837,727	2,138,391	1,932,555	104,358	2,289,731
Increase (+) or decrease (−)	−48.62	−1,005	+23,602	+13,898	−2,369,079	−358,494	+740,394	+39,982	−305,619

In 1910 the production of gold, silver, copper, and zinc in Tennessee was valued at $2,289,731, a decrease of $305,619 from the corresponding value for 1909. The gold production was 150.59 fine ounces, valued at $3,113; the silver production, 81,239 fine ounces, valued at $43,869; the copper output, 16,837,727 pounds, valued at $2,138,391; and the zinc production, figured as spelter, 1,932,555 pounds, valued at $104,358. Comparing these with the corresponding figures for 1909 we find decreases of $1,005 in the production of gold, and in copper of 2,369,079 pounds in quantity and of $358,494 in value; but increases in silver of 23,602 fine ounces in quantity and of $13,898 in value, and in zinc of 740,394 pounds in quantity and of $39,982 in value.

There were 24.19 fine ounces of gold and 2 ounces of silver recovered from gold placers in 1910, and 126.40 fine ounces of gold and 81,237 fine ounces of silver, together with all the above given copper production, recovered from copper ores. One gold placer, 2 copper mines, and 2 zinc mines were productive in Tennessee in 1910. There were mined 578,434 short tons of ore in 1910, of which 552,796 tons were of copper ore and 25,638 tons were of zinc ore. In 1909 576,680 tons of copper ore and 34,334 tons of zinc ore were mined.

Jefferson County.—The Loy mine and the Tennessee Mineral mine, near Newmarket, in Jefferson County, were both producers of zinc ore in 1910. The ores are concentrated and the concentrates are shipped to zinc smelters. The Tennessee Mineral mine is worked by open cuts and tunnels, and the concentrating plant at this mine includes a crusher, rolls, jigs, and tables. A new crusher and new rolls were added in 1910. The capacity of the mill is from 65 to 100 tons in 12 hours. The ore is zinc blende in dolomite gangue. The Loy mine is also worked principally by open cut, but the ores produced are mainly carbonates. The plant has a capacity of 90 tons in 10 hours, and the ore is concentrated by log washer, jigs, and tables. A steam shovel, engine, and tram cars were utilized to handle the overburden of clay.

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Knox County.—Development work only was done on the Holston zinc mine near Mascot in Knox County in 1910. The property is opened by a 200-foot vertical shaft, and work done was mainly in prospecting with churn drills.

Monroe County.—Gold placers on Coker Creek, in Monroe County, made a nominal output of gold in 1910.

Polk County.—The well-known Ducktown copper mines in Polk County made their usual important production of copper, with incidental output of silver and gold, in 1910. The Burra Burra, London, Polk County, and Eureka mines of the Tennessee Copper Co. are developed by shafts 980 feet, 700 feet, 588 feet, 485 feet, and 165 feet deep, respectively, and are equipped with a 2,000-ton smelter and converter plant. The Eureka mine, newly developed, is opened by a shaft 165 feet deep, of which 141 feet of work was done during 1910. The ore of these mines is pyritically treated and the Bessemer copper is exported to Europe. The Mary and the East Tennessee mines of the Ducktown Sulphur, Copper & Iron Co. (Ltd.) are opened by vertical shafts 300 feet to 700 feet deep. The old Calloway mine was abandoned in 1910. The equipment includes a 600-ton smelter, in which semipyritic smelting produces 20 per cent matte, which is resmelted to 45 per cent matte.

Sullivan County.—In Sullivan County considerable prospecting for zinc ore has lately been carried on. The prospects near Fall Branch of the Eastern Tennessee Mining & Development Co. are developed by a 180-foot shaft and a 300-foot tunnel and are equipped with a 100-ton dry concentrating plant.

VERMONT.

There was no production of copper, silver, or gold reported from the mines of Vermont in 1910. The Corinth, the Elizabeth, and the Pike Hill copper mines, of Orange County, were all inactive.

VIRGINIA.

Mine production of gold, silver, copper, lead, and zinc in Virginia in 1909 and 1910.

Years.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1909	181.41	$3,750	4,825	$2,509	224,162	$29,141
1910	42.96	888	128	69	5,402	686
Increase (+) or decrease (−)	−138.45	−2,862	−4,697	−2,440	−218,760	−28,455

Years.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1909			116,627	$6,298	$41,698
1910	198,850	$8,750	1,588,112	85,758	96,151
Increase (+) or decrease (−)	+198,850	+8,750	+1,471,485	+79,460	+54,453

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The value of the production of gold, silver, copper, lead, and zinc in Virginia in 1910 was $96,151, an increase of $54,453 over the corresponding value for 1909.

The production of gold was 42.96 fine ounces, valued at $888, a decrease of 138.45 ounces in quantity and of $2,862 in value. The output of silver was 128 fine ounces, valued at $69, a decrease of 4,697 ounces and of $2,440. The production of copper decreased from 224,162 pounds, valued at $29,141, in 1909, to 5,402 pounds, valued at $686, in 1910; but the output of lead increased from nothing in 1909 to 198,850 pounds, valued at $8,750, in 1910, and the production of zinc increased from 116,627 pounds (figured as spelter), valued at $6,298, in 1909, to 1,588,112 pounds, valued at $85,758, in 1910.

The production of gold in Virginia in 1910 included 4.36 fine ounces from placers, 32.12 fine ounces from dry or siliceous ores, and 6.48 fine ounces from copper ores. The silver production was all from copper ores. There were 7 producing gold, silver, copper, lead, and zinc mines in Virginia in 1910, and of these 1 was a placer and 6 were deep mines. The total tonnage credited as the output of Virginia in 1910 and producing the 5 metals mentioned was 16,976 short tons, of which 239 tons was gold-quartz ore, with an average extraction value in gold and silver of $2.78 per ton; 271 tons was copper ore, with an average extraction of $0.75 in gold and silver, and 686 pounds of copper per ton; 6,400 tons was lead ore with no gold or silver but an average extraction of 31.1 pounds of copper per ton; and 10,066 tons was zinc ore with no precious metals but an average recovery per ton of 157.8 pounds of zinc. Owing to the small number of producers of copper, lead, and zinc in Virginia in 1910, further details on the output of these metals may not be disclosed.

REVIEW BY COUNTIES.

Albemarle County.—The old Faber lead-zinc mine in Albemarle County has been abandoned and the plant has been dismantled, and the former operating company has reported work done there as unprofitable.

Campbell County.—The former manganese property in Campbell County, near Lynch, known as the Bishop mine, was prospected for copper in 1910, but no production was reported.

Floyd County.—There was a nominal output of placer gold reported from Floyd County in 1910.

Fluvanna County.—At the Scotia property, near Columbia, in Fluvanna County, which is opened by several shallow shafts, prospecting was carried on from February to September, 1910. In the latter month operations were suspended pending the introduction of hoisting equipment. The gold ores are reported to be oxidized to a depth of 45 feet.

Goochland County.—In Goochland County in 1910 a small output of gold was reported, principally from the Argus and the Gilmer mines. The latter mine, near Lantana, is developed by several shallow shafts, and by drifts, crosscuts, and winzes, and was equipped in 1910 with a 10-foot slow-speed Chilian mill and a Traylor concentrating table for crushing, amalgamation, and concentration.

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Halifax County.—There was no activity reported at the Gold Banks gold mine in the Virgilina belt in Halifax County in 1910, and there was no output of metal from any of the copper mines in this county. Exploration work at the Kay mine resulted in production of a small quantity of copper ore, which awaits treatment. There was some prospect in 1910 of the erection of a water-power plant and mill in the district.

Louisa County.—Operators of the pyrite mines of Louisa County, which produce some copper in ore and as cement, and incidental silver and gold as by-products, reported little output of these three metals in 1910.

Prince William County.—There was no production of copper, silver, and gold reported from the copper ores of the Cabin Branch pyrite mine near Dumfries in Prince William County in 1910.

Spotsylvania County.—Considerable development work was reported from the Holladay and Grindstone prospects, near Holladay, in Spotsylvania County, in 1910. These prospects are said to contain gold, pyrite, and silver-lead-zinc deposits of considerable promise.

Warren County.—Development work only was reported from the Cooney Manor copper mine near Front Royal, in Warren County, in 1910.

Wythe County.—In Wythe County the lead-zinc mines continued operations in 1910, but there was no output of gold and silver from these ores.

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QUICKSILVER.

By H. D. McCaskey.

INTRODUCTION.

Preliminary figures on the production of quicksilver in 1910 were given to the press by the United States Geological Survey about the middle of January, 1911, and would have been available on the first of the year but for delays in replies to Survey inquiries on the part of very few producers. This is the second year in which the plan has been tried of furnishing early statistics to the trade and the efforts of the Survey seem to be appreciated. A delay due to a small number of operators is much to be regretted, however, and it is to be hoped that responses, both for preliminary and for final figures for 1911, will be prompt in every case.

In the preliminary figures for 1910 the Survey reported an output of 17,410 flasks for Califorina, 145 flasks for Nevada, and 3,382 flasks for Texas, a total for the United States of 20,937 flasks of 75 pounds each. Revised and final confidential figures furnished by every quicksilver producer in the United States in 1910 give totals of 17,211 flasks for California, 70 flasks for Nevada, and 3,320 flasks for Texas, a total of 20,601 flasks for the United States, or 338 flasks less than the preliminary figures give. This indicates an error of 1.6 per cent in the early statistics—a difference not sufficient to impair their usefulness, but much in excess of the corresponding error for 1909. It is hoped that producers will cooperate to reduce this error for 1911 by more careful returns of preliminary figures to the Survey.

CONDITION OF THE INDUSTRY.

A good domestic demand for quicksilver was noted during 1910, principally for gold milling and placer mining, for manufacture of vermilion and fulminates, and to a small degree for making physical instruments and drugs, and for lighting. The use of quicksilver in making fulminate is increasing in importance probably more than any other, but the domestic demand for use in the recovery of silver from its ores has become almost negligible. Consumption for all purposes was somewhat greater than domestic production, stocks decreased to a small supply, and the condition of the trade within the United States was good throughout 1910. A marked decrease in imports, satisfactory prices, a good demand, and a decreasing domestic production, gave excellent home markets to the producers and the exports of domestic quicksilver were the smallest in the last

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30 years. The total production is expected to show a further decrease for 1911 and the probabilities indicate a practical exhaustion of stocks by the end of the year.

PRODUCTION.

In 1910, as in 1909, there were 19 mines producing quicksilver in the United States, of which 15 were in California, 2 were in Nevada, and 2 were in Texas. There was no output of metal from Arizona, Oregon, Utah, or Washington.

The production of quicksilver in the United States in 1910, as obtained from confidential returns to the Survey by every producer in the country, was 20,601 flasks of 75 pounds avoirdupois each. At the average domestic price at San Francisco in 1910 of $46.51 per flask, the value was $958,153.[1] As compared with the production of 1909, which was 21,075 flasks, valued at $957,859, this shows a decrease for 1910 of 474 flasks, but an increase in value of $294. Although the production of California increased from 16,078 flasks in 1909 to 17,211 flasks in 1910, the output from Oregon decreased to nothing as that of Arizona did in 1909, the small Nevada production fell off considerably, and the output from Texas decreased from 4,188 to 3,320 flasks. In no State, except possibly Nevada, can an increased output be expected for 1911, the present outlook being for a total production for the United States not exceeding 20,000 flasks.

The following table shows the production and the value for 1909 and 1910:

Production of quicksilver in the United States in 1909 and 1910, in flasks of 75 pounds.

State.	1909		1910	
	Quantity.	Value.	Quantity.	Value.
California	16,078	$730,745	17,211	$800,484
Nevada and Oregon [a]	809	36,769	70	3,256
Texas	4,188	190,345	3,320	154,413
Total	21,075	957,859	20,601	958,153

[a] Output of Nevada for 1909 includes small production in 1908. No production in Oregon in 1910.

TONNAGE AND RECOVERY.

Producers reported 131,813 short tons of new ore mined and available for treatment in 1910, and the treatment during the year of 123,562 short tons of ore including small tonnages of crude ore concentrated before reduction. There were treated in California 115,306 short tons of crude ore, producing 15,825 flasks of quicksilver, indicating an average recovery of 0.5 per cent of the ore treated, or 10.3 pounds of metal per ton of ore. There were also produced in California 1,386 flasks from clean up of old plants. The corresponding figures for 1909 showed that 144,989 tons of ore were treated in California, yielding an average recovery in metal of 0.4 per cent of

[1] In 1909 the Survey published the value of the quicksilver production by counties, States, and for the United States as that reported by producers, who were dealers in many cases. For uniformity, however, the values for the year 1910 and hereafter will be the domestic values at San Francisco, and, for purposes of comparison, the values for 1909 in this report have been computed also on the same basis.

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the ore treated, or 8 pounds of quicksilver to the ton. In Texas, in 1910, there were treated 8,221 tons of ore, yielding an average of 1.5 per cent of metal or 30.3 pounds of quicksilver per ton of ore, as against a treatment of 9,107 tons in 1909 yielding 1.7 per cent or 34.5 pounds of metal per ton. In Nevada and Oregon combined, in 1909, there were treated approximately 406 tons of ore yielding 6.5 per cent of metal or 131 pounds per ton; and in Nevada alone there were treated in 1910 about 35 tons of ore yielding 7.5 per cent or 150 pounds of quicksilver per ton. There were treated in 1910 in the United States 123,562 short tons of crude ore yielding 0.6 per cent of metal or 11.7 pounds of quicksilver per ton of ore. In 1909 154,502 tons yielded an average recovery of 0.5 per cent, or 10 pounds of metal per ton.

The production in California is almost wholly from shaft furnaces of Scott, Litchfield, and related types, a very small proportion of the output coming originally from retorts. The output from Oregon has been from a Dennis experimental furnace, and that from Nevada entirely from retorts. The Texas ores are all treated in Scott furnaces.

The following table gives the tonnages treated with recoveries, by States, for 1909 and 1910:

Quicksilver ore treated and average recoveries, by States, in 1909 and 1910.

State.	1909			1910		
	Short tons treated.	Pounds of metal recovered per ton.	Percentage.	Short tons treated.	Pounds of metal recovered per ton.	Percentage.
California	144,989	8	0.4	115,306	10.3	0.5
Nevada and Oregon [a]	406	131	6.5	35	150	7.5
Texas	9,107	34.5	1.7	8,221	30.3	1.5
Total and average United States	154,502	10	.5	123,562	11.7	.6

[a] No production in Oregon in 1910.

From this table it is seen that the average grade of ore treated increased slightly in 1910 in the United States and in California, but that a slight decrease was shown for Texas. The average gross value of recovered metal per ton of ore treated in the United States in 1910 was $7.26 as against $6.06 in 1909. The increase indicated was owing to increased average recovery, due undoubtedly to increased grade of ore, as shown above, and also to the higher average price for 1910.

RESOURCES AND DEVELOPMENT.

ARIZONA.

There was no production in 1910 in the Plomosa mining district in Yuma County, Ariz. The deposits have been known for many years, but the total production of quicksilver to date has been small. Work in drifting on the sixth level of the Colonial Mining Co.'s mine, near Quartzsite, in the latter part of the year is reported to have uncovered ore. The present operator is the Cinnabar Development

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Co., of Chicago. The property was visited and briefly described by Bancroft,[1] who writes as follows:

The rocks in this locality are arenaceous shales, presumably of pre-Cambrian age, which have been metamorphosed into quartz-mica schists. * * * The country rock in which the deposit worked by the Colonial Mining Co. occurs is unlike most of the schists in the vicinity in that it contains small crystals of magnetite scattered through the rock in large quantities.

The vein worked by the Colonial Mining Co. strikes S. 55° E. and is practically perpendicular. It occupies a fault zone which shows intense brecciation of the country rock. The gangue is highly siliceous and is cut by small stringers of calcite and siderite, the former occurring in places in conspicuous quantities, but being entirely absent in the croppings of the vein, where silica with a little black oxide of manganese forms the ledge. In width the vein varies from a few inches to several feet; parallel breccia planes of small magnitude, which accompany the main fault in places, tend to widen the deposit. The ore shoot in the property is said to pitch to the southeast.

Cinnabar is very sparsely distributed through the gangue and is supposed to be found mainly on the northeast side of a very plastic, iron-stained gouge which has resulted from the extreme movement in the fault zone. The ore in places is conspicuously marked by the green carbonate of copper, and Turner has reported gold and silver in ores from this deposit. The presence of magnetite near the vein is a feature worthy of note; its alteration has probably formed the red and yellow stains so common in the brecciated vein material and gouge.

Considering the facts that late eruptions are absent in the vicinity, that the deposit is highly oxidized, that copper stains are prominent, and that values of gold and silver occur in the vein, it seems highly probable that the cinnabar has been derived from mercurial tetrahedrite.

CALIFORNIA.

The production of quicksilver in California in 1910 was 17,211 flasks, valued at $800,484. Compared with the output for 1909 this shows an increase of 1,133 flasks in quantity and of $69,739 in value. In 1910 California furnished 83.5 per cent of the total production of the United States as against 76 per cent in 1909.

The following table shows the production of California, by years, since 1850:

Total production of quicksilver in California, 1850–1910, in flasks.[2]

1850	7,723	1871	31,686	1892	27,993
1851	27,779	1872	31,621	1893	30,164
1852	20,000	1873	27,642	1894	30,416
1853	22,284	1874	27,756	1895	36,067
1854	30,004	1875	50,250	1896	30,765
1855	33,000	1876	72,716	1897	26,691
1856	30,000	1877	79,395	1898	31,092
1857	28,204	1878	63,880	1899	29,454
1858	31,000	1879	73,684	1900	26,317
1859	13,000	1880	59,926	1901	26,720
1860	10,000	1881	60,851	1902	28,972
1861	35,000	1882	52,732	1903	30,526
1862	42,000	1883	46,725	1904	29,217
1863	40,531	1884	31,913	1905	24,635
1864	47,489	1885	32,073	1906	20,310
1865	53,000	1886	29,981	1907	17,431
1866	46,550	1887	33,760	1908	16,984
1867	47,000	1888	33,250	1909	16,078
1868	47,728	1889	26,464	1910	17,211
1869	33,811	1890	22,926		
1870	30,077	1891	22,904	Total	2,085,358

[1] Bancroft, Howland, Notes on the occurrence of cinnabar in central western Arizona: Bull. U. S. Geol. Survey No. 430, 1910, pp. 151–153.

[2] 76½ pounds net; 75 pounds net since June 1, 1904.

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There was reduced production of quicksilver in 1910 in Colusa, Napa, San Luis Obispo, and Trinity counties, and increased output in Lake, San Benito, and Santa Clara counties. The county leading in production was San Benito, in which are the New Idria mines, the most important quicksilver producers on the continent. Following San Benito was Santa Clara County, with the New Almaden and the Guadlupe mines, both important producers; and third in rank was Lake County, whose chief producers in 1910 were the Great Western and the Helen mines.

There were 15 quicksilver mines in California contributing to the output in 1910, as in 1909. The total tonnage mined was 119,072 short tons, as against 158,623 tons in 1909. In 1910 there were treated in California 115,306 tons of ore and furnace products, producing 17,211 flasks of quicksilver, valued at $800,484, as against a treatment of 144,989 tons in 1909, producing 16,078 flasks, valued at $730,745. The average recovery of metal from crude ore in California in 1910 was 10.3 pounds per ton treated, or 0.5 per cent of the ore, as against 8 pounds, or 0.4 per cent, in 1909. These figures indicate an average gross return of $6.39 per ton in 1910, against $4.85 in 1909.

The production of quicksilver in California in 1909 and 1910 is shown by counties in the following table:

Production of quicksilver in California, by counties, during 1909 and 1910, in flasks of 75 pounds.

County.	1909		1910	
	Quantity.	Value.	Quantity.	Value.
Colusa	17	$773	.....	.....
Lake	1,065	48,404	1,148	$53,394
Napa	1,670	75,901	621	28,883
San Benito	8,900	404,505	10,804	502,494
San Luis Obispo	370	16,817	[a] 533	24,790
Santa Clara	3,522	160,075	4,038	187,807
Sonoma	344	15,635	67	3,116
Trinity	190	8,635	(a)	(a)
Total	16,078	730,745	17,211	800,484

[a] San Luis Obispo and Trinity combined for 1910.

Colusa County.—The quicksilver mines of Colusa County made no output in 1910. The Manzanita mine, in the Sulphur Creek district, made a small production in 1909.

On the Ruby-King property a new discovery of quicksliver ore was made and considerable development work was done. The ore is reported to assay from 0.5 to 8 per cent of metal.

Eldorado, Fresno, and Kings counties.—There was no production reported from Eldorado or Kings Counties nor from Little Panoche district in Fresno County in 1910.

Lake County.—The mines of the Clear Creek district in Lake County made no output of quicksilver in 1910. In the Mayacmas district development and construction work, including the alteration and enlargement of the furnace, was reported at the Chicago mine, and production was expected for 1911. The clean-up at the Great Western mine continued, and an output of metal was recovered from

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the old furnace and condensers. At the Helen mine a new tunnel was driven and some metal was obtained from the treatment of the ore in a 50-ton Scott furnace, with prospects of increased output for 1911.

At the Wall Street mine there was a small production from the D retorts, which treat concentrates reported to yield 35 pounds of metal to the ton, obtained from crude decomposed serpentine carrying 6 pounds of metal. A new discovery of furnace ore was reported in 1910. There was no output reported from the Sulphur Creek district in Lake County in 1910.

There were 1,630 tons of ore mined in Lake County in 1910, and the treatment of 630 tons yielded 1,148 flasks of quicksilver valued at $53,394. In 1909, 7,765 short tons were reported as mined and 7,715 tons as treated with a recovery of 1,065 flasks valued at $48,404.

Mendocino and Monterey counties.—There was no production of quicksilver from Mendocino or Monterey counties in 1910. At the Summit mine, near Parkfield, trouble with the retorts, resulting in frequent salivation, was reported.

Napa County.—The Knoxville district, including the Manhattan and other mines in Napa County, made no production of quicksilver in 1910. In the Mayacmas district a small output of quicksilver was made at the Ætna mines from the clean-up from former furnace operations. Parts of old mine workings were reopened during the year and a bench of two new retorts was erected. A considerable output was made from clean-up of the dismantled plant of the Napa Consolidated mine, but no ore was produced and the property is reported permanently closed. Prospecting only was reported at the Twin Peaks mine in 1910, and the reopening and development of the Bella Union mine was reported stopped by litigation in the early part of the year. At the Knoxville mine ore was stoped and a 30-ton furnace was prepared for operation, but the production for 1910 was reported from clean-up of old furnaces. The prospects are for an increased output for 1911.

From these notes it will be seen that the entire production of 621 flasks of quicksilver in Napa County in 1910, valued at $28,883, was from clean-up of old plants, although 800 tons of ore were reported mined. In 1909 the county produced 1,670 flasks of metal, valued at $75,901.

San Benito County.—In the central San Benito or Cerro Bonito district, in San Benito County, there was no production of metal, but the mining of a small tonnage was reported from the Bradford mine, which is equipped with a 6-ton furnace. The other prospects were idle, as were all those of the Stayton district, in the northern part of the county.

In the New Idria district work on the erection of a smelter was reported from the Aurora mines of the Esmeralda group. The Florence Mac mine, at Hernandez, yielded a nominal output from ore obtained in development work and treated in a pipe retort, and increased production was indicated for 1911. The Ramirez or Picachos mine also made a nominal output. The New Idria mine remained the most important producer of quicksilver on the continent in 1910, and yielded practically the entire output of the county and over half the entire product of the United States. According to published reports the production of this mine for the calendar year 1910 was

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10,800 flasks from the treatment of 73,208 tons of ore. This shows an increase of 1,900 flasks over the output for 1909, and an average recovery of 11.06 pounds of metal per ton, or 0.55 per cent. The published gross earnings of the company were $463,243, the net earnings $186,939, and the dividends paid $160,000. Surface workings were extensive in 1910, the east end being practically worked off, but further ore remaining in the west end. Underground, especially above levels 1, 2, and 3, considerable work was done in the east end and ore was reported showing there, as well as above level 5 and elsewhere. Prospecting indicated considerable reserves, and much further development is expected, especially down to level 10. In the San Carlos property exploration was done for the ore body below level 5.

The total quantity of ore reported as mined in San Benito County in 1910 was 73,510 short tons, and the total output of quicksilver reported was 10,804 flasks recovered from the treatment of 73,211 tons of ore. The average recovery for the county was therefore 11.02 pounds of metal per ton, or 0.55 per cent. In 1909 the total quantity of crude ore mined in the county was 72,297 short tons, and that treated was 67,247 tons, yielding 8,900 flasks of metal, or 9.93 pounds per ton, or 0.5 per cent. The ore treated in 1910 was, therefore, of slightly better average grade than that of 1909.

San Luis Obispo County.—There was no production of quicksilver in the Adelaide, Pine Mountain, or San Carpojo districts in San Luis Obispo County in 1910, although development work was carried on, and repairs were made to the 50-ton Scott furnace, at the Klau or Sierra Morena mine of the Adelaide district. In the Oceanic district the Cambria mine was closed in 1910, but the Oceanic mine yielded a considerable output under lease. This was the only producer in the county for 1910 and the figures for production are combined with those for Trinity County to avoid disclosing individual output.

Santa Barbara County.—There was no production of quicksilver in 1910 in Santa Barbara County.

Santa Clara County.—In Santa Clara County in 1910 the New Almaden and the Guadalupe mines continued their important output and remained, after the New Idria mines, the largest producers in California. The plant at the Guadalupe mine consists of two fine-ore and two coarse-ore modified Litchfield furnaces of Davey construction and patent. This property was recently described by De Kalb,[1] from whose paper the following extracts are taken:

> The original main shaft was sunk in the valley close to the channel of the Capitancillos Creek, and the workings reached a depth of about 1,100 feet. Much difficulty was experienced with water in the mine, and the decreasing tenor of the ore rendered economical mining impossible. The hills on both sides of the creek were also extensively prospected, and considerable ore found. The deposit now worked is at a depth of about 700 feet under the hills on the north side of the creek, and is reached by an adit over 2,000 feet long. The cinnabar occurs in serpentine in proximity to intrusive masses of rhyolite. The exact content of the ore is not known, but the extraction is quite complete. Of the total recovery as much as 63 per cent is obtained as metal direct from the condensers, the remainder being extracted from the soot. This result is probably due in large part to the fact that oil is now used as fuel, and the combustion being quite perfect, the amount of soot produced is small. * * *
>
> The ore on coming to the works is crushed in a Hendy rock breaker, 8 by 12 inches, the feeder consisting of a short trommel, thus avoiding the recrushing of material

[1] De Kalb, Courtenay, Guadalupe quicksilver works: Min. and Sci. Press, vol. 100, 1910, pp. 446–447.

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already fine enough for the furnaces. An elevator takes the product to a screen with 1½-inch holes, dividing it into coarse and fine grades which are distilled in separate furnaces. The average size of the coarse ore treated is 3 inches. * * * The Litchfield furnace used at the Guadalupe mine * * * has 8 distillation chambers, or "channels," 40 feet high and 3 by 6 feet each, in horizontal section, the block being 30 by 18 feet in plan. The upper part of each channel contains a constriction called a "throat," which the ore completely fills as it passes through. Above the throat is a drier, consisting of a prolongation upward of the channel, fitted with additional inclined tiles. This device is an improvement patented by H. C. Davey. An auxiliary fire is used to effect the drying in this upper shelf furnace. The condensers at the Guadalupe works are brick chambers, 2 in number, placed tandem. They are of red brick, and are 12 by 40 feet in plan and 20 feet high. From these the fume passes through a series of brick flues, 2 by 3 feet, expanding into smaller condensing chambers at frequent intervals. The total travel of the fume from the retort furnaces to the stack is 3,000 linear feet, and draft is induced by a 6-foot fan placed at the entrance to the stack. The fan is driven by a 2-horsepower motor. There are 2 blocks of furnaces, the fine-ore furnace having a capacity of 30 tons per diem, while the coarse-ore block treats 12 tons. Calcined ore is drawn off every hour. The oil burned amounts to 1 barrel to each 10 tons of ore distilled. The soot was formerly distilled in iron retorts, but is now treated on concrete "soot tables" 12 feet long by 8 feet wide, made in the form of a broad, shallow V-shaped trough, inclined from the head toward the discharge end. The soot is placed on the sloping floor of this table, where it is hoed with ordinary garden hoes at frequent intervals. The metal collects into globules of sufficient size to run out of the soot, which is left undisturbed a few hours after each hoeing. In this way the extraction is so perfect that but little quicksilver remains, and the soot is then returned to the ore fed into the top of the distilling furnaces. * * *

Labor in the works consists of 3 men to each shift of 8 hours. Sixty men in all are employed, above and below ground. Extensive improvements are under way, including the installation of a 125-horsepower Pelton wheel to take water under a head of 734 feet. This will drive air compressors for drilling in the mine in addition to operating the surface works. At the present time 75 horsepower is consumed, this being developed by a water wheel.

At the New Almaden mine ore was obtained in 1910 for both fine and coarse ore furnaces from open cuts at outcrops of the old ore bodies on Mine Hill and from a new prospect being opened up. Sixty-five men were employed in extracting ore from the open cuts. No underground work was done at Mine Hill, and the pumps were out and the lower levels drowned. The upper levels have caved in part, and the old mines were inaccessible except for short distances through the Harry tunnel.

Reports from Santa Clara County give a total tonnage mined during 1910 of 36,994 short tons of ore and the treatment of 35,442 short tons from which were recovered 4,038 flasks of quicksilver valued at $187,807, or 8.54 pounds of metal per ton, or 0.4 per cent. The tonnage reported mined in 1909 was 41,482 short tons; and that treated was 39,971 short tons, yielding 3,522 flasks of quicksilver, valued at $160,075, or 6.61 pounds of metal per ton, or 0.3 per cent. These figures show that the average grade of ore treated in Santa Clara County is below that for the State and for the United States, and is the lowest treated in the country. The increase in average yield for 1910 was notable.

Siskiyou and Solano counties.—In Siskiyou County the Minnie Ha Ha and Siskiyou mines were not productive in 1910, but development work at the latter mine was reported to indicate good prospects for 1911.

In Solano County the St. John mine made no output in 1910, only development work and construction of a new 60-ton furnace to be fired with oil as fuel being reported.

Sonoma County.—The Mayacmas district, extending through Lake, Napa, and Sonoma counties, includes 19 or more quicksilver claims

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or groups in Sonoma County, but only two of these were productive in 1910. At the Cinnabar King mine some work in cleaning out old workings and retimbering was reported during the year, and at the Cloverdale mine there was a small production of ore from prospecting operations and of metal from sampling and from clean-up from previous furnace work. The Cloverdale furnace is of the incline type, with 4 channels 16 feet long and 2 feet by 1 foot in section, with a reverberatory furnace at the base 4 by 12 feet inside, and with a daily capacity of 24 tons of ore. At the Clyde mine a small amount of underground and surface work was reported for 1910, but there was no furnace at this mine for treating ore. A small production was reported from the Culver-Baer mine in 1910, but development only was reported for the Eureka mine. The Socrates and Great Eastern mines were shut down and no operations from the remaining quicksilver properties of the county were reported for 1910.

The ore reported as mined in Sonoma County in 1910 amounted to 140 short tons and that treated was 25 tons, yielding 67 flasks of quicksilver valued at $3,116, or an average of 201 pounds of metal per ton, or 10 per cent. In 1909 the county production of ore was 2,121 short tons, of which 2,021 tons were treated, yielding 344 flasks of quicksilver, valued at $15,635, or an average of 12.76 pounds of metal per ton, or 0.6 per cent.

Stanislaus County.—In Stanislaus County development work was reported at the Deer Park mine, but there was no output from this or from the Summit and Grayson mines.

Trinity County.—In Trinity County there was a production reported from the Altoona mine in 1910. The fine-ore furnace in use has a daily capacity of 30 tons. There was none but assessment work done at the Integral mine.

Yolo County.—There were no operations of any kind on quicksilver properties in Yolo County in 1910.

NEVADA.

The total production of ore mined in Nevada in 1910 was reported as 320 short tons, of which 35 tons were treated, yielding 70 flasks of quicksilver, valued at $3,256, or an average recovery of 150 pounds of metal per ton, or 7.5 per cent. The figures for Nevada for 1909 were combined with those of Oregon to prevent disclosure of individual output and comparisons for the State for both years can not therefore be made. For the two States combined in 1909 the reports from producers gave a tonnage mined of 2,176 short tons, of which 406 tons yielded 809 flasks of quicksilver, valued at $36,769, an average recovery of 131 pounds of metal per ton, or 6.5 per cent. The decreased output in Nevada in 1910 was due to suspension of work at the Shoshone mines in Nye County, pending erection of a furnace, as the retorts used caused salivation of the workmen. Increased output may be expected from Nevada.

Humboldt County.—In Humboldt County in 1910 the Dixie mine, near Fitting, made a small production. The ore is crushed in a Huntington mill and concentrated, and the concentrates are treated in pipe retorts. The reduction plant was reported completed and ready for operations on July 1. Development work only was reported from the Nevada-Almaden and the Ruby mines. Small furnaces were in prospect of erection at these properties in 1911.

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Nye County.—The properties of the Mercury Mining Co., near Ione, in Nye County, were developed in 1910, and ore was raised for treatment in a 20-ton Scott furnace to be erected in 1911. At the Shoshone mines there was a small output, but the work done was mainly in development and exploration for locating and defining the ore shoots. The reduction plant consists of 9 retorts, the previous operations of which on rich ore had caused serious salivation.

OREGON.

There was no production of quicksilver from Oregon in 1910, and reports do not indicate an output from that State for 1911.

Crook County.—In Crook County the Almaden property, near Prineville, was idle in 1910.

Douglas County.—Development work only was done at the Red Cloud property, near Drew, in Douglas County, in 1910.

Lane County.—The Black Butte mine, near Black Butte, in Lane County, was inactive in 1910.

TEXAS.

The production of quicksilver in Texas in 1910 was 12,421 short tons of ore mined, 8,221 tons of ore treated, and 3,320 flasks of quicksilver, valued at $154,413, or an average recovery of 30.3 pounds of metal per ton, or 1.5 per cent. In 1909 the output was 12,807 tons mined, 9,107 tons treated, and 4,188 flasks recovered, valued at $190,345, or an average recovery of 34.5 pounds per ton, or 1.7 per cent. Of the total production of the United States, Texas furnished 20 per cent in 1909 and 16 per cent in 1910. Owing to the suspension of operations at one of the largest mines the production of Texas will probably show a decrease for 1911.

The following table shows the quicksilver production of Texas by years:

Production of quicksilver in Texas, 1899–1910, in flasks.[1]

1899	1,000	1906	4,761
1900	1,800	1907	3,686
1901	2,932	1908	2,382
1902	5,319	1909	4,188
1903	5,029	1910	3,320
1904	5,336		
1905	4,723	Total	44,476

Brewster County.—The total quicksilver production of Texas to date has been from Brewster County, in which three adjoining productive localities in the Big Bend country may be recognized—Terlingua, Chisos, and Study Butte, which extend east and west, close to the Rio Grande in the southwest portion of the county. Field studies have been begun by the writer on this region, and the results will be published as a bulletin of the Survey. Cinnabar has been discovered in outlying areas, as on Christmas Mountain to the northeast and on Mariscal Mountain to the southeast, but there has been little more than prospecting in these areas. The remoteness of the region, the difficulty of transportation, and the State mining laws have greatly hindered the development of the Texas field. The Terlingua locality, which has yielded the largest total production to date, lies

[1] 76½ pounds net; 75 pounds since June 1, 1904.

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west of the great fault along the Long Draw and is a rugged area of uplift of Lower Cretaceous limestones and shales cut by Tertiary volcanic rocks. This includes the Marfa and Mariposa, the Terlingua, the Colquitt-Tigner, and other properties, of which the Marfa and Mariposa mines in California Hill, the largest producers to date outside of California, alone were productive in 1910; and these were closed down indefinitely in May, 1910. In the Chisos locality of Upper Cretaceous thin-bedded limestones and shales, east of the great fault, are the old McKinney-Parker and the present Chisos mines, the latter of which, an active producer throughout 1910, has workings over 500 feet deep, which cut the upper members of the Lower Cretaceous. Farther to the east, in the igneous rocks, lie the Big Bend and the Texas-Almaden mines of the Study Butte locality, which were inactive during 1910. Each of these properties in Brewster County is well equipped with Scott furnaces of the best construction, and the metallurgical practice in the district, profiting by the results of California experience and of intelligent local study, has been excellent.

UTAH.

Tooele County.—There has been no output of quicksilver since 1907 from the Sacramento mine of the Mercur district, which has been the only Utah producer in recent years.

WASHINGTON.

Kittitas County.—There has been no production as yet from the quicksilver prospects of the Washington Quicksilver Co. in Kittitas County.

WORLD'S PRODUCTION.

The following table gives the world's production of quicksilver, in metric tons of 2,204.6 pounds, for the years 1903–1910. For foreign countries the quantities given are partly from the corrected figures of the Seventeenth Annual Issue of Comparative Statistics, compiled by the Metallgesellschaft, Metallurgischen Gesellschaft A. G., and the Bergund Metallbank Aktiengesellschaft, of Frankfort on the Main, Germany; for the United States the figures are those of the United States Geological Survey; and for Spain for 1907 and 1908 they are those of United States Consular Agent A. E. Carleton, published in the Daily Consular and Trade Report No. 3585.

World's production of quicksilver, 1903–1910, in metric tons.

Country.	1903	1904	1905	1906	1907	1908	1909	1910
United States	1,237	1,188	1,036	892	734	672	717	701
Austria-Hungary	575	550	570	577	610	630	609	694
Italy	313	357	369	418	423	680	771	a 800
Russia	362	332	318	210	130	49	7	4
Spain	968	1,130	853	1,567	1,210	1,065	a 1,000	a 1,000
Mexico	188	a 190	a 190	a 200	a 200	a 200	a 200	a 200
Total	3,643	3,747	3,336	3,864	3,307	3,296	3,304	3,399

a Partly estimated.

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IMPORTS AND EXPORTS.

According to returns from the Bureau of Statistics of the Department of Commerce and Labor, the imports of quicksilver for consumption in the United States dropped from 15,968 pounds, valued at $8,203, in 1909, to 667 pounds, valued at $381, in 1910. The exports of domestic quicksilver, which in 1909 had increased to 6,802 flasks, valued at $266,243, the highest figures since 1905, fell off in 1910 to 1,923 flasks, valued at $91,077, the lowest figures since 1905. The excess in value of exports over imports was $258,040 in 1909, but, as appears from the tables, it decreased in 1910 to $90,696—practically the value of the exports.

Quicksilver imported and entered for consumption in the United States, 1905–1910, in pounds.

Year.	Quantity.	Value.
1905	2,690	$1,710
1906	84	50
1907	16,567	6,719
1908	15,113	8,216
1909	15,968	8,203
1910	667	381

Exports of quicksilver from the United States, 1905–1910, in flasks of 75 pounds.

Year.	Quantity.	Value.
1905	13,534	$489,756
1906	6,456	243,914
1907	5,132	192,094
1908	2 996	124,960
1909	6,802	266,243
1910	1,923	91,077

As the foreign market for domestic production is of interest to those engaged in the industry, the following table has been prepared for the purpose of presenting in detail the distribution of exports from the United States during 1909 and 1910:

Exports of domestic quicksilver from the United States in 1909 and 1910, by foreign countries, in pounds.

Country.	1909		1910	
	Quantity.	Value.	Quantity.	Value.
Canada	421,136	$214,037	81,745	$52,590
Costa Rica	.....	.....	2,475	1,585
Honduras	144	95	1,194	763
Nicaragua	4,704	2,839	1,979	1,212
Panama	118	70	285	175
Salvador	151	90	375	220
Mexico	81,035	47,446	48,678	29,736
Cuba	165	90	.....	.....
Santo Domingo	5	4	20	17
Brazil	.....	.....	1,081	757
Colombia	863	495	2,718	1,630
Dutch Guiana	.....	.....	95	63
Venezuela	165	99	26	18
Chosen (Korea)	1,054	617	1,950	1,314
Philippines	601	361	1,616	997
Total	510,141	266,243	144,237	91,077

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The exports to Canada and Mexico, our most important foreign markets, fell off greatly during 1910. Among the minor markets increased demand is noted from Costa Rica, Honduras, Panama, Salvador, Brazil, Colombia, Dutch Guiana, Chosen (Korea), and the Philippines, and decreased demand from Nicaragua, Cuba, and Venezuela. There have been no exports to Japan and China for several years.

In the following table are given the exports from San Francisco in 1909 and 1910:

Exports of domestic quicksilver from San Francisco in 1909 and 1910, by countries, in flasks of 75 pounds.

Country.	1909		1910	
	Quantity.	Value.	Quantity.	Value.
Canada	18	$839	34	$1,559
Costa Rica	.....	.....	32	1,530
Honduras	.....	.....	15	720
Nicaragua	2	90	5	250
Salvador	2	90	5	220
Mexico	928	41,134	517	24,184
Colombia	.....	.....	1	51
Chosen (Korea)	14	617	26	1,314
Philippines	8	361	13	605
Total	972	43,131	648	30,433

PRICES.

Prices of quicksilver continued in 1910 the improvement begun in 1907, as shown by the following table:

Average yearly prices of quicksilver in the United States, and highest and lowest London quotations, from 1907 to 1910, inclusive.

Year.	San Francisco (flask of 75 pounds).		New York (flask of 75 pounds).	London (bottle of 34.5 kilos).	
	Domestic.	Export.		Highest.	Lowest.
				£ s. d.	£ s. d.
1907	$39.60	$38.17	$41.50	8 5	6 15
1908	44.17	42.54	44.84	8 10	7 12 6
1909	45.45	43.45	46.30	9 17 6	7 19
1910	46.51	44.51	47.06	9 15	8

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BAUXITE AND ALUMINUM.

By W. C. PHALEN.

INTRODUCTION.

Although the growth of the bauxite and aluminum industry was not phenomenal during 1910, certain branches of the aluminum trade made substantial progress. The United States was the leading producer of bauxite in 1909, the production in this country having exceeded that of France for that year. The price of the American ore per ton has for many years considerably exceeded that of the French product, but some French bauxite has been imported in spite of the protective duty of $1 per ton on the crude ore imported. The imports, however, have been steadily falling off, and during 1910 they reached their lowest figure since 1905.

With respect to the trade in metallic aluminum, the following statement was made at the beginning of the year by Mr. Arthur V. Davis,[1] president of the Aluminum Co. of America. Since Mr. Davis is in a position to speak with the highest authority with regard to the conditions of the metallic aluminum business, the statement by him is quoted in full.

The volume of aluminum business in 1910 was less than that in 1909, and from the same causes which resulted in a diminution of output in all other lines of production. In the first quarter of 1910 the demand was good, even better than in any quarter of 1909, but by the end of the second quarter of 1910 business receded to less than 50 per cent of the first quarter and has been, if anything, gradually decreasing since. The demand for aluminum in steel for the purpose of deoxidizing suffered a net decrease proportionate to the decrease in the steel business. The demand for aluminum castings, which is largely confined to the automobile trade, also fell off in connection with the slump in the automobile industry. A number of aluminum foundries shut down and the rest ran with lessened output, and the result was that the demand for ingot for this purpose, as well as for other purposes, was so reduced that it is this branch of the aluminum industry which showed the greatest falling off. The sheet and wire business did not fall off so much, and some of the specialties even improved.

As a result of the decline in demand large stocks of aluminum accumulated and are still accumulating. In the hope of an improved demand the Aluminum Co. of America ran its smelting plants at nearly full capacity for some time, although a substantial amount of the aluminum produced had to be stored. Now some of the plants have been cut back half, and unless the demand improves still further cutting back will be necessary.

As above noted, however, some branches of the business made material progress. The use of aluminum, particularly aluminum tubing, in paper, chemical, and other similar lines of manufacturing made a steady growth and seems to promise a substantial and large volume of business for the future. The use of aluminum in extruded shapes has also been constantly increasing. This business was started about three years ago, and though no single line takes a large quantity of any one shape, an increasing number of new consumers are constantly being discovered, with the result that the extruded-shapes output is constantly increasing, and the Aluminum Co. of

[1] Eng. and Min Jour., vol. 91, No. 1, Jan. 7, 1911, p. 21.

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America in 1910 installed a separate plant of considerable size for this purpose. The aluminum cooking-utensil business was also good. These articles seem to have merit and win their way despite adverse commercial conditions.

Although a new sheet-rolling mill was built at Niagara Falls in 1910, it was not put into operation on account of the falling off in the sheet business, but as the mill was built to meet future requirements, it is still expected that the time will come when this mill will be required.

The aluminum wire and cable business, of course, followed the electrical-installation business. There have been comparatively few transmission lines financed and built in the last few years, and though there was apparently some activity in 1909, present commercial conditions seem to have checked the revival.

BAUXITE.

USES.

The chief uses of bauxite are (1) as raw material in the production of metallic aluminum; (2) in the manufacture of aluminum salts; (3) in the manufacture of artificial abrasives; and (4) in the manufacture of bauxite brick.

(1) The use of bauxite in the production of metallic aluminum is by far the most important of those enumerated above. A large part of the entire output of Arkansas is used in the metallic aluminum industry, and the figures of production from this State have shown phenomenal growth during recent years. The production of bauxite in Arkansas increased 9 per cent in 1910 as compared with 1909, over 200 per cent in 1909 as compared with 1908 and over 70 per cent as compared with 1907, and the production of this State during each of the last two years has exceeded the production of the entire country during any year prior to 1909. A large part of the French product is also used in the manufacture of metallic aluminum.

(2) Only the purer bauxite is used in the manufacture of chemicals, such as alum, aluminum sulphate, and aluminum salts in general. Freedom from oxide of iron is essential in the material to be used in the chemical manufactures.

(3) Bauxite is used on a large scale in the manufacture of the artificial abrasive, alundum, at Niagara Falls. This abrasive is made in the electric furnace by fusing calcined bauxite. It is high in crystalline aluminum oxide, and virtually amounts to a form of artificial corundum. Its quality is under complete control, and hence it can be duplicated with ease in the various abrasive products, a factor of great importance in any successful abrasive industry. Alundum is particularly efficient in the grinding of steel. Further information relating to alundum and recent patents with reference to an improved form may be found in another portion of this volume under the heading of artificial abrasives.

(4) The use of bauxite in the manufacture of refractory brick has by no means reached a perfected stage, but it is understood that several manufacturers are now experimenting on processes in which it is admixed with other materials. The life of bauxite-brick linings is as yet undetermined, though it is known to exceed by far the life of silica or fire-clay brick. The high cost of raw material, as well as that of its manufacture, makes the ultimate cost of bauxite brick excessive as compared with that of the other two bricks mentioned. Some satisfactory results are claimed to have been obtained by an anonymous experimenter [1] in tests made on Arkansas bauxite.

[1] The Clayworker, vol. 51, No. 4, 1909, p. 591.

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These tests have demonstrated the nonaffinity of bauxite for the metals, lime, cements, etc., and have shown it to have resisting qualities at high temperatures.

PRODUCTION.

The production of bauxite in the United States in 1910 amounted to 148,932 long tons, valued at $716,258. As compared with 1909 this was an increase of 19,831 tons, or 15 per cent, in quantity, and of $36,811, or 5 per cent, in value. These increases appear to be normal in every respect. It must be recalled that the bauxite production during 1909 showed a remarkable increment over that of 1907, the next preceding year of normal business conditions. It would be expecting too much to have that rate of increase continue. The business seems to have attained a normal condition, and unless some unforeseen demand arises, its growth will quite likely continue at a rate probably not greatly different from that indicated for 1910. The average price per ton at the mines for the last three years has been, 1908, $5.06; 1909, $5.26; 1910, $4.81.

The States which produced bauxite in 1910 were, as heretofore, Alabama, Arkansas, Georgia, and Tennessee. The industry in Arkansas has shown great growth during the last few years, the production increasing over 200 per cent in 1909, as compared with 1908, and over 70 per cent as compared with 1907. The figures in 1910 as compared with 1909 show an increase of 9 per cent. The production of Georgia showed an increase of 16 per cent as compared with that of 1909. The value of the Georgia product, however, decreased slightly in spite of the increased output. Alabama showed the greatest individual gain among the States, both as to quantity and value of product. The industry in Tennessee continued in a healthy condition, and the returns for 1910 did not show any marked differences from those of 1909.

The following table gives the production and value of bauxite from 1889 to 1910, inclusive:

Production of bauxite in the United States, 1889–1910, by States, in long tons.

Year.	Georgia.	Alabama.	Arkansas.	Total.	Value.
1889	728	.....	.....	728	$2,366
1890	1,844	.....	.....	1,844	6,012
1891	3,301	292	.....	3,593	11,675
1892	5,110	5,408	.....	10,518	34,183
1893	2,415	6,764	.....	9,179	29,507
1894	2,050	9,016	.....	11,066	35,818
1895	3,756	13,313	.....	17,069	44,000
1896	7,313	11,051	.....	18,364	47,338
1897	7,507	13,083	.....	20,590	57,652
1898	.....	.....	.....	25,149	75,437
1899	15,736	14,499	5,045	35,280	125,598
1900	19,739		3,445	23,184	89,676
1901	18,038		867	18,905	79,914
1902	22,677		4,645	27,322	120,366
1903	22,374		25,713	48,087	171,306
1904	21,913		25,748	47,661	235,704
1905	15,173		32,956	48,129	240,292
1906	25,065		50,267	75,332	368,311
1907	.....	.....	.....	[a] 97,776	480,330
1908	14,464		[a] 37,708	52,167	263,968
1909	22,227		[a] 106,874	129,101	679,447
1910	33,096		[a] 115,836	148,932	716,258

[a] Production of Tennessee included.

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CONSUMPTION.

The following table gives the annual production, imports, consumption, and value of bauxite in the United States during the last five years. The importation of foreign bauxite continues to show a steady decline, while the amount consumed in this country continues to show a steady increase. The United States deposits, therefore, are being drawn upon more and more to satisfy such domestic demand as exists.

Production, imports, and consumption of bauxite in United States, 1906–1910, in long tons.

Year.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906	75,332	$368,311	17,809	$63,221	93,141	$431,532
1907	97,776	480,330	25,066	93,208	122,842	573,538
1908	52,167	263,968	21,679	87,823	73,846	351,791
1909	129,101	679,447	18,688	83,956	147,789	763,403
1910	148,932	716,258	15,669	65,743	164,601	782,001

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite from 1907 to 1909. One noteworthy feature of this table is that the production in the United States in 1909 exceeded the production of France for the first time in the history of the world's bauxite industry.[1]

World's production of bauxite, 1907–1909, in long tons.

Country.	1907		1908		1909	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	97,776	$480,330	52,167	$263,968	129,101	$679,447
France	155,834	323,282	167,991	326,987	128,099	251,188
United Kingdom	7,537	9,137	11,716	14,671	9,500	11,679
Italy	3,445	6,080	6,890	12,160	3,881	7,610
India	.....	.....	(a)	(a)	(b)	(b)
Total	264,592	818,829	238,764	617,786	270,581	949,924

a Production of 32 long tons; value not available. b Statistics not available.

NOTES ON THE DOMESTIC BAUXITE INDUSTRY.

Arkansas.—The bauxite deposits worked in Arkansas in 1910 are in Saline and Pulaski counties. Both the American Bauxite Co. and the Republic Mining & Manufacturing Co. mined ore in this field during 1910.

Alabama and Georgia.—The deposits in northwest Georgia and northeast Alabama are comprised in one bauxite field in which the

[1] The figures for France were taken from the Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie pour l'année 1909.

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geologic and structural relations of the ore deposits are the same. The district as a whole extends along the Coosa Valley from the vicinity of Summersville or Adairsville, Ga., to Jacksonville, Ala., and lies chiefly in Bartow and Floyd counties, Ga., and Cherokee County, Ala. Not the whole of the district is developed or even well prospected, so that from time to time new deposits may be discovered. In Alabama in 1910 operations were conducted by the Republic Mining & Manufacturing Co., near Rock Run, Cherokee County. In Georgia the National Bauxite Co. and the Republic Mining & Manufacturing Co. were active in Floyd County. R. A. Asbury, a new producer, reported work at the Gordon and Culbertson mines, located near Cave Spring, Floyd County. In Bartow County John H. Hawkins operated part of the year, and among the newer producers the Cherokee Mining Co. was active.

Tennessee.—The bauxite deposits in Mission Ridge, near Chattanooga, were worked in 1910 by the National Bauxite Co. So far as structural and geologic relations are concerned, this field may be considered a northward extension of that described above in Alabama and northwest Georgia.

Bauxite field in central Georgia.—The details connected with the new bauxite field in Wilkinson County, Ga., were published in the reports for 1908 and 1909. The report for the latter year is not yet out of print, and for that reason those details will not be repeated here. The reader is referred to the publications noted above and also to the report by Otto Veatch, cited in the bibliography at the end of this chapter, for a full description of the geologic occurrence, character, and origin of the bauxite deposits in the Wilkinson County field.

NOTES ON FOREIGN BAUXITE DEPOSITS.

France.—The principal French deposits of bauxite are located in the departments of Hérault, Bouches-du-Rhône, and Var, in southeast France, near the Italian border. From Toulon they extend in a westward direction toward the foot of the Pyrenees. The first valuable beds of ore were discovered in the vicinity of Les Baux, in the department of Bouches-du-Rhône, northwest of Marseille, which accounts for the name of the mineral—bauxite.

The ore occurs in two varieties, distinguished both by chemical composition and by color, as white ore and red ore. The white ore contains but little iron and much silica, and serves well in the manufacture of alum and aluminum sulphate. In such chemical manufactures the presence of iron oxide is a disadvantage, as it colors the product, and only ore low in iron oxide is sought for the purpose. The red ore is adapted to the manufacture of pure alumina used in the extraction of metallic aluminum. In the refining process of this red bauxite a high percentage of iron oxide is not objectionable, but a high percentage of silica, on the other hand, is a great drawback. Some analyses of French bauxite are given in the following table:

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Analyses of French bauxite.

	1	2	3	4	5	6
Silica (SiO_2)	2.8	4.8	.....	2.0	0.30	2.20
Titanium oxide (TiO_2)	3.1	3.2	.....	1.6	3.40	4.00
Alumina (Al_2O_3)	57.6	55.4	30.3	33.2	69.30	76.90
Ferric oxide (Fe_2O_3)	25.3	24.8	34.9	48.8	[a]22.90	a.10
Calcium carbonate ($CaCO_3$)	.4	.2	12.7	[b]5.8	.....	.....
Water	10.8	11.6	22.1	8.6	14.10	15.80
	100.00	100.00	100.00	100.00	.....	.....

[a] Includes both ferrous and ferric oxide (FeO and Fe_2O_3). [b] Corindon.

1. Compact bauxite, no locality given.
2. Similar in appearance to 1, pisiform variety; d'Allauch near Marseille.
3. Hard and compact calcareous paste, Baux.
4. Calabres. Analyses 1–4, from M. H. Coquand, Sur les bauxites de la chaine des Alpines (Bouches-du-Rhône) et leur âge géologique: Bull. Soc. géol. de France, 2d ser., vol. 28, 1870–1871, p. 101. M. H. Sainte-Claire Deville, analyst.
5. Red bauxite, Thoronet, Var.
6. White bauxite, Villeveyrac, Hérault. Analyses 5–6, from M. Augé, Note sur la bauxite, son origine, son âge, et son importance géologique: Bull. Soc. géol. de France, 3d ser., vol. 16, 1888, p. 345.

In these analyses No. 3 may be taken as a type of the red variety, between which and the white there are a great many intermediate types. It constitutes the most important deposits in the Commune of Baux. The type represented in analysis No. 6 from Villeveyrac, Hérault, and an equally pure type which has been found at Loupian in the same department, are unfortunately rare. In the department of Hérault the bauxite does not form regular deposits, the composition of the ore varies a great deal, and frequent analyses are necessary to enable the miners to prepare homogeneous shipments.

In Bouches-du-Rhône, where bauxite was first utilized as an ore of aluminum, the mines are not of great importance, The bauxite of Les Baux and Iaradon is used principally in the manufacture of fire brick. The best ore is found in the department of Var. The ore is red and homogeneous, with low specific gravity. It is easily crushed. Some white grains of almost chemically white alumina occur in it. Some of the Var bauxite is shipped to Germany, England, and America.[1]

Italy.—Italy has attained some prominence as a producer of bauxite and metallic aluminum. There is but one establishment engaged in the aluminum industry, which is located at Bussi di Tirino, Province of Aquila. The output of bauxite in Italy is given in the table on world's production.

ALUMINUM.

PRODUCTION.

The magnitude of the aluminum industry is shown in the table following, which gives the production since the beginning of the industry in 1883 and the domestic consumption of the metal since 1904:

[1] Callot, T., Eng and Min. Jour., June 11, 1910, p. 1229.

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Production, in pounds, of aluminum in the United States, 1883–1910.

1883	83	1898	5,200,000
1884	150	1899	6,500,000
1885	283	1900	7,150,000
1886	3,000	1901	7,150,000
1887	18,000	1902	7,300,000
1888	19,000	1903	7,500,000
1889	47,468	1904	[1] 8,600,000
1890	61,281	1905	[1] 11,347,000
1891	150,000	1906	[1] 14,910,000
1892	259,885	1907	[1] 17,211,000
1893	333,629	1908	[1] 11,152,000
1894	550,000	1909	[1] 34,210,000
1895	920,000	1910	[1] 47,734,000
1896	1,300,000		
1897	4,000,000	Total	193,626,779

EXPORTS.

The value of exports of aluminum and of manufactures of aluminum of domestic production for the last five years has been as follows:

Exports of aluminum of domestic production, 1906–1910.

1906	$364,521	1909	$567,375
1907	304,938	1910	949,215
1908	330,092		

The increase in the exportation of metallic aluminum and of manufactures of metallic aluminum during the last few years is noteworthy.

THE ALUMINUM MARKET.[2]

At the beginning of January, 1910, the price of aluminum was unchanged from what it had been late in 1909, namely, 20 to 23 cents per pound for ingot metal. These prices continued throughout January, and there was practically no change until late in February. At that time the market was disturbed by some domestic stocks in second hands, from which offers were made as low as 21 cents for ingots. Owing to an advance in Europe, however, the price at which foreign metal could be obtained in this country was materially raised. Importers quoted 22¾ to 23 cents, New York delivery, duty paid. American metal was sold to meet these prices, and toward the end of February No. 1 ingots were quoted at 22½ to 23½ cents and the market became stronger, as a result of old stocks being fairly well cleared out. Abroad prices continued to rise; large producers were well sold up and there was a general unwillingness to quote for future deliveries. About the middle of March prices advanced to 23 to 23½ cents for ingots, and a further advance seemed possible in view of the growing demand. In Europe the market continued strong. A rise of a quarter of a cent per pound took place near the end of March, bringing the price of No. 1 ingots up to 23¼ to 23¾ cents per pound, but even at these prices sellers were reluctant to quote far ahead, expecting further advances, owing to the increased demand. Business

[1] Consumption.

[2] Under the Payne-Aldrich Tariff Act of August, 1909, aluminum, aluminum scrap, and alloys of any kind in which aluminum is the component material of chief value, in crude form, are dutiable at 7 cents per pound, and plates, sheets, bars, and rods, at 11 cents per pound instead of 8 cents and 13 cents, respectively.

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remained active at the above quotations until the middle of May, when a slight rise was reported and No. 1 ingots were quoted at 23¾ to 24 cents per pound in large lots in New York. These were the highest quotations for the year. Early in June the metal was quoted at 23¾ cents per pound for No. 1 ingots. The market then became more quiet, falling to 23½ cents per pound, and toward the end of the month the figure reached 23¼ cents. The foreign market also at this time was reported to be slightly easier. The market remained in this condition until the end of July, when prices were quoted at 22¾ to 23 cents per pound for No. 1 ingots in large lots, New York City. The market became quieter and prices fell gradually from 22¾ cents in early August to 21½ to 22 cents in early September, which figures continued up to November, when for a short period the market strengthened in sympathy with advances abroad and quotations were 23 to 23½ cents. Late in November the figures sank to 22½ to 23 cents for No. 1 ingots, and remained so until the end of the year, when No. 1 ingots could be had at 22½ cents with the market still on the decline at the beginning of 1911.

PROGRESS OF THE ALUMINUM INDUSTRY.

The year 1910 was one of progress in the aluminum industry taken as a whole, but particularly so in that branch of the industry having to do with processes of manufacture and new applications of the metal. Many inventions were patented relating to almost all branches of the metallurgy of aluminum and its use in alloys. The condition of the industry from a purely commercial viewpoint has already been outlined and will not be considered further here.

The expiration of the aluminum-process patents and the great increase in output of metallic aluminum, have given rise to many scientific researches and commercial inquiries regarding new methods of producing metallic aluminum. These inquiries are appropriate in view of the fact that bauxite is found in comparatively few places, must be transported long distances, and contains so much silica as to require costly chemical operations to purify it in the manufacture of metallic aluminum. Aluminum silicates, on the other hand, are found almost everywhere, and the separation of the silica from them may, at some future time, not cost more than to counterbalance the scarcity, inaccessibility, and impurities of the bauxite deposits. In this report for 1909 a most interesting group of inventions was mentioned as having been patented by F. J. Tone, of the Carborundum Co., of Niagara Falls, having for their object the production of silicon from kaolin and the formation of pure alumina as a by-product. Further work along this line has been done by Alf Sinding-Larsen (Patent No. 927,758, July 13, 1909), who proposes to treat silicates of alumina like feldspar, clay, and kaolin in the electric furnace in contact with scrap iron or iron ore and coke. As a result of the treatment a layer of fused ferrosilicon is formed at the bottom and slag containing aluminum oxide at the top. This aluminum oxide may be further treated in the preparation of metallic aluminum.

In Metallurgie for January 8, 1911, Max Moldenhauer concludes, from several electric furnace experiments, that the question of the use of silicates in the manufacture of metallic aluminum has been practically solved. By mixing aluminum silicate with iron ore and car-

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bon in the electric furnace, the product is ferrosilicon and an alumina slag containing only a very little silica and iron oxide. The slag may be pulverized, the globules of ferrosilicon removed by magnetic separation, and the alumina used in preparing metallic aluminum. Among other new methods recently patented for the preparation of metallic aluminum is one by A. G. Betts (Patent No. 938,634, Nov. 2, 1909). Betts proposes to use iron and aluminum ore, the latter in the form of either bauxite or clay. These ores are charged with fuel into a blast furnace, different from the ordinary furnace in that a higher temperature is used in the smelting section of the furnace. During the smelting process silicon is formed and there results an alloy of iron, aluminum, and silicon. The latter may be then treated with iron sulphide, the reaction being carried out in two stages. The aluminum sulphide which is formed is converted by electrolysis into aluminum and sulphur.

F. J. Tone (Patent No. 961,913, June 21, 1910) describes a process for the reduction of aluminum ore as follows: In the first step aluminum ore is reduced with the proper amount of carbon to aluminum carbide, which in the second step is used as a reducing agent in place of carbon for the reduction of ores of various elements to alloys of aluminum with these elements or for the reduction of aluminum ores to metallic aluminum. For example, in the manufacture of a silicon—aluminum alloy corresponding to the formula 8Al.3Si—aluminum carbide and silica are taken in the proportions expressed by the chemical equation $2Al_4C_3 + 3SiO_2 = 8Al.3Si + 6CO$. The materials are subjected to heat in the electric furnace, and the silicon-aluminum alloy results. If the element aluminum is to be obtained as a final product, a mixture of aluminum carbide and aluminum oxide is made in accordance with the equation $Al_4C_3 + Al_2O_3 = 6Al + 3\ CO$.

METHODS OF PREPARING PURE ALUMINA.

The two processes of manufacture which have transformed the metal aluminum from a chemical curiosity to a commercial commodity—the Hall and the Hérault processes—were patented in America and Europe about the same time (1888 and 1886). The alumina is prepared from bauxite in as pure a state as possible, and it is subjected to electrolytic extraction. The practical working details as carried out at Niagara Falls at the present time are not generally known, but the main features of the Hall process, as operated at Niagara Falls in the nineties, have been described by J. W. Richards in the work cited in the bibliography at the end of this chapter. Important modifications in the process of manufacture in recent years have been made in the methods of preparing the pure alumina from bauxite. It has been found that the degree of purity of the metal separated in the electrolytic bath is largely dependent upon the absence of impurities, chiefly silica, iron, etc. Much more care, therefore, is now given to this part of the manufacture. One of the recent patents having to do with the preparation of pure alumina is that of Gilbert McCulloch (Patent No. 941799, Nov. 30, 1909) from the text of which the following quotation is taken.

McCulloch discovered that in the process of precipitation, alumina is precipitated first, and that the silica is mainly precipitated at the end of the operation, and that by arresting the precipitation before it is completed the bulk of the silica may be retained

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in solution along with a portion of the alumina and sodium carbonate and may be run back to the digesters for treatment with additional bauxite and caustic lime. The silica which is thus returned with the sodium carbonate liquor to the digesters does not accumulate in the liquor, but acts as the silica which is introduced as an impurity with the bauxite. The great bulk of the silica present, namely, that which is in the solution and that which is introduced with the bauxite, remains in undissolved form with the undissolved portions of the bauxite and calcium carbonate, if lime is used, and constitutes what is known as red mud. * * *

The following table shows approximately the ratio at which the alumina and silica precipitate where the original solution contains approximately 0.25 gram of silica per liter:

Proportionate precipitation of alumina and silica.

When 50 per cent of alumina has been precipitated, 4 per cent of silica has been precipitated.

When 75 per cent of alumina has been precipitated, 8 per cent of silica has been precipitated.

When 80 per cent of alumina has been precipitated, 12 per cent of silica has been precipitated.

When 87 per cent of alumina has been precipitated, 25 per cent of silica has been precipitated.

When 94 per cent of alumina has been precipitated, 80 per cent of silica has been precipitated.

When 100 per cent of alumina has been precipitated, 100 per cent of silica has been precipitated.

With a liquor containing more silica, the ratio tends to lessen earlier in the reaction, while in a liquor containing less silica the ratio tends to lessen later in the reaction. From the silica content of the liquor one is enabled to determine just when to stop the precipitation to obtain any degree of purity desired from the silica standpoint.

The above simply serves as an example, as with solutions containing more silica the precipitation would be stopped earlier, and with solutions containing less silica the precipitation may be continued until a larger proportion of alumina is precipitated.

Instead of filtering the aluminum hydrate and running the liquor back to the digesters to take up a new charge of alumina from bauxite, the liquor containing a small proportion of alumina may after filtration be run back to the agitators or to other agitators and the precipitation completed by means of CO_2 gas, giving an inferior grade of aluminum hydrate which would be useful for some purposes.

RECENT APPLICATIONS OF ALUMINUM.

As stated in a previous part of this chapter, some branches of the aluminum business made material progress during 1910. The use of aluminum tubing in paper, chemical, and other lines of manufacture, showed a steady growth and promises much for the future. This subject was barely mentioned in the report for 1909 and may properly be amplified in this place.[1]

Aluminum possesses the quality of resisting the corrosive action of many substances which affect copper, brass, and bronze—among others, sulphates, nitrates, ammonia, and organic acids. Manufacturing plants having occasion to handle any of these in solution are likely to obtain good results by the substitution of aluminum.

In the manufacture of paper pulp by the sulphite process, one of the obstacles has been the difficulty of securing a metal that will not be affected by sulphurous acid gas and which at the same time is free from mechanical drawbacks. Sulphurous acid gas is an essential feature of the sulphite pulp process and the pipes required for handling it in a large mill are quite extensive. Prior to the introduction of aluminum, bronze pipe was commonly used, but it deteriorates rapidly under the action of SO_2 gas, and its replacement has been a constant source of expense. Aluminum, on the other hand, is but slowly affected by the gas, and an installation of it can be regarded as practically permanent. * * *

The production of ammonia as a by-product of coke involves the use of condensing apparatus to cool the ammonia gas, either at the top of the concentrator or in a separate compartment near by. Pure ammonia is destructive to copper and copper alloys, and the usual impurities in crude ammonia, viz, hydrogen sulphide, sulphurous, and sul-

[1] Davis, E. K., The Metal Industry, March, 1910, pp. 121–122.

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phuric acid gas, attack iron. Aluminum has the double quality of resisting ammonia and its common impurities. Some of the large by-product coke oven companies use it, but its use has not spread to the smaller companies. * * *

One of the principal uses of aluminum tubing, as well as other forms of aluminum, is in the manufacture of stearic acid and in the production of soap, candles, and other products where stearic acid is the principal constituent. Stearic acid for use in soaps should be free from color, a result which is impossible to secure if the apparatus and pipes by which it is made and carried from place to place are made of copper. The verdigris which gathers on copper surfaces during the periods when the apparatus is not in use wears off and stains the product in the first few days of operation. In stearic acid for candles any mineral matter is likely to gather on the wick of the candle and cause it to burn irregularly. As aluminum has been found to be absolutely free from corrosion by stearic and similar acids, it is used in practically all candle factories and many soap concerns having careful regard to the quality of product. * * *

The principle of protecting one metal by another which is electropositive to it, has a striking example in aluminum-lined condenser tubes. The principle is the same as that of coating black iron plate with zinc, i. e., by making what is known as galvanized iron. Zinc is electropositive to iron; consequently when a sheet of steel is coated with zinc and afterward exposed to the weather, the moisture existing in the air causes galvanic action between the steel plate and its zinc covering. The zinc rather than the iron is affected and a thin coating of zinc oxide, very resistant to corrosion, is formed and prevents the iron from being attacked. Similarly, copper coated with aluminum, as in the case of an aluminum-lined condenser tube, is not affected by the action of whatever cooling agents may be passing through the tube, until such time as the aluminum lining, which is generally also quite resistant to corrosive action, has been eaten away. Condenser tubes made on this principle have been known to last twice as long as brass and copper under similar circumstances. * * *

The insistent demand for light-weight gas engines for motor boats, automobiles, and last but not least in importance, the flying machine, has led to the extensive use of aluminum in the construction of these motors. Cylinder heads, pipes, frames, etc., are now cast of this wonderful white metal, but the cylinder for many years resisted the efforts of the engine builder when aluminum was tried as a substitute for gray iron. All experiments with aluminum cylinders have failed, as this metal wears away rapidly as the result of the piston travel, and good compression can not be maintained.[1]

ALLOYS.

The subject of alloys of aluminum with other metals is a large one and can be treated here only to the extent that concerns the alloys latest mentioned in the literature and in the trade. Among the most recently mentioned of these alloys is one known as duralumin, the invention of A. Wilm, of Schlachtensee, Berlin, Germany. It contains 90 to 95 per cent of aluminum and is claimed to have the same properties as good Bessemer steel. Its specific gravity is 2.8, that is, about one-third that of iron or brass. It possesses great hardness even when annealed, and working it cold increases this quality. Its melting point is 650° C. (1,202° F.).

The subject of aluminum bronzes has recently been described by A. H. Hiorns.[2] The alloys containing 90 per cent copper and upward are those employed in the industries. Copper-aluminum alloys have a gold color up to 14 per cent of aluminum, and beyond that they are grayish-white or white. Up to 10 per cent of aluminum the alloys are malleable, but beyond that they are brittle. With 20 per cent of aluminum they can be crushed in a mortar. Hiorns also describes the subject of bronzes with aluminum. These must not be confounded with aluminum bronzes, consisting of copper and aluminum only, as the former contain very small quantities of aluminum, in fact only enough to reduce the oxides in the copper-tin alloys, to which the aluminum is added.

[1] Iron Trade Rev., Mar. 31, 1910, p. 609. [2] The Metal Industry, vol. 8, No. 4, April, 1910, p. 166.

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A new alloy said to consist of aluminum and copper is reported to have been placed on the market under the name of "cupsor."[1] In color it resembles gold. It polishes readily and takes a high luster, and is therefore adapted to jewelry and ornamental purposes. It is highly resistant to chemical influences. It can be readily machined, rolled, and drawn into wire. From the descriptions it would seem to belong in the group of aluminum bronzes.

Another alloy which has been recently mentioned is "clarus." The composition of this alloy is not given. It is claimed to have many advantages. Still another alloy is known as "atherium." A comparatively recent British patent[2] describes an aluminum-lead alloy, a combination which it has been considered hitherto impossible to produce.

ALUMINUM SALTS.

The following table gives the domestic production, the imports, and the value of aluminum salts from 1906 to 1910, inclusive:

Production and imports of aluminum salts into the United States, 1906–1910, in short tons.

Year.	Production.						Imports.[a]	
	Alum.			Aluminum sulphate.			Quantity.	Value.
	Quantity.	Value.	Per ton.	Quantity.	Value.	Per ton.		
1906.....	15,613	$450,125	$28.83	89,246	$1,613,050	$18.07	1,183	$23,193
1907.....	10,404	361,900	34.78	106,821	2,008,046	18.80	1,562	35,191
1908.....	7,700	236,710	30.74	97,255	1,835,213	18.87	1,407	24,929
1909.....	9,237	295,682	32.01	115,366	2,214,122	19.19	1,459	29,061
1910.....	9,090	300,763	33.09	126,792	2,447,552	19.30	2,127	53,671

[a] Includes alumina, aluminum hydrate, or refined bauxite, alum, alum cake, aluminum sulphate, aluminous cake, and alum in crystals or ground.

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ANTIMONY.

By FRANK L. HESS.

Production.—The only production of antimony in the United States during 1910 was made as a by-product in electrolytic lead refining.

The price of antimony in 1910 was so low that there was little encouragement for American mines to attempt an output. In Nevada a few tons of antimony ore were produced in development work near Austin in the Toyabe Range, and in Indiana some by-product antimony was produced, as already noted, in the electrolytic lead refinery of the United States Metals Refining Co. at Grasselli—these items constituted about the sum of operations in antimony during 1910. As has been frequently stated, most if not all of the American antimony deposits are too small, or they are too far away from cheap transportation, or wages are too high, or some combination of these circumstances or of other circumstances makes antimony mining unprofitable, unless the price of the metal reaches the phenomenal height of 1906 and 1907, when at one time the better grades brought 28 cents per pound.

Although little antimony ore or metal is produced in this country, a considerable quantity of antimony is saved in antimonial lead, which is as real a production as if it had been smelted separately and then combined with the lead, since there is a demand for antimonial lead which otherwise would have to be met by alloying the two metals.

The production of antimony in the United States since 1903 has been as follows:

Production of antimony in the United States, 1903–1910, in short tons.

Year.	Contained in antimonial lead of domestic origin.		Contained in antimonial lead of foreign origin, but smelted in the United States.		Antimony produced from domestic ore.		Recovered from old alloys, scrap, dross, etc.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	2,558	$445,092	.....	.....	570	$103,341	.....	.....
1904	2,571	443,598	.....	.....	[a] 486	61,926	.....	.....
1905	2,747	588,354	.....	.....	493	117,433	.....	.....
1906	1,362	[b] 544,800	.....	.....	[c] 404	58,149	.....	.....
1907	1,561	[d] 508,886	.....	.....	[c] 351	77,300	.....	.....
1908	2,246	[e] 359,360	.....	.....	[f]	[f]	.....	.....
1909	1,617	[g] 252,252	743	[g] $115,908	[f]	[f]	1,556	[g] $242,736
1910	1,598	[h] 263,431	631	[h] 103,906	.....	.....	2,779	[h] 457,979

[a] Estimated from the average content of the ore.
[b] Estimated from the prices current for the year.
[c] Figured as 60 per cent of domestic ores only; direct figures from the smelters could not be obtained.
[d] Estimated, using 16.3 cents as the average price per pound.
[e] Estimated, using 8 cents as the average price per pound.
[f] None produced from domestic ore. Figures not collected for foreign ores.
[g] Estimated, using 7.8 cents as the average price per pound.
[h] Estimated, using 8.24 cents as the average price per pound.

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The values given in the table are arbitrary and must not be taken as indicating exact values. Antimonial lead generally contains impurities such as arsenic, iron, and copper, and it is impracticable to obtain pure antimony and pure lead from the alloy at such a figure that a profit can be gained, though the alloy sells at a lower price than the metals singly. A rule by which antimonial lead is sometimes sold is to add the price of the contained antimony, supposing it to be equal to Cookson's, to that of the contained lead and then to subtract $5 per ton. For lack of a better basis, for the year 1910 the value of the antimony content has been figured at 8.24 cents per pound, the average price of Cookson's during the year.

Imports.—There enters into the consumption of the country a large quantity of antimonial lead imported under the name of type metal, for which it is largely used.

The following table showing imports of type metal for consumption is taken from the records of the Bureau of Statistics:

Type metal imported and entered for consumption, 1899–1910, in short tons.

Year.	Type metal.		Antimony content.[a]	
	Quantity.	Value.	Quantity.	Per-centage.
1899	555	$56,442	.....	.....
1900	516	51,242	.....	.....
1901	1,611	116,875	.....	.....
1902	3,235	194,394	.....	.....
1903	3,302	208,728	.....	.....
1904	4,072	221,127	630	15.5
1905	6,966	456,156	1,228	17.6
1906	9,801	900,608	1,853	18.9
1907	7,416	932,027	1,369	18.4
1908	2,055	156,847	422	20.5
1909	6,997	532,108	1,327	19.0
1910	6,697	485,493	1,109	16.1

[a] Prior to 1904 the composition of the type metal was not given.

In the following table the imports of antimony and antimony ore for consumption, as obtained from the Bureau of Statistics, are given since 1899 in order to show the great variation in both quantity and value of the imports from year to year. Importations of salts of antimony are given only since 1903, the earliest year for which the survey has obtained statistics.

Antimony, antimony ore, and salts of antimony imported and entered for consumption in the United States, 1899–1910, in pounds.

Years.	Metal and regulus.		Crude antimony and ore.		Oxide and salts of antimony.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1899	2,990,915	$241,685	3,968,654	$47,427	.....	.....	$289,112
1900	3,654,822	287,937	6,089,134	75,866	.....	.....	363,803
1901	3,640,505	254,529	1,682,301	22,720	.....	.....	278,066
1902	5,388,739	333,601	3,129,069	62,968	.....	.....	396,569
1903	4,694,309	260,144	2,714,617	54,316	916,468	$66,469	330,929
1904	4,268,045	248,726	2,488,518	50,414	981,026	70,668	369,808
1905	4,941,247	431,228	1,970,788	53,026	1,010,228	80,130	564,384
1906	10,305,734	1,391,289	1,972,658	125,841	764,070	99,251	1,616,279
1907	9,600,901	1,407,961	2,771,387	180,903	682,102	98,033	1,686,802
1908	8,089,915	771,206	3,287,218	106,930	623,125	65,898	944,034
1909	9,557,956	620,117	3,453,542	94,249	955,360	60,353	774,719
1910	7,955,945	492,570	1,346,962	47,185	326,136	14,201	553,956

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Secondary antimony.—The production of secondary antimony—that is, of antimony recovered from waste materials—in the United States in 1910, as ascertained by John P. Dunlop, of the United States Geological Survey, was 9 short tons, and 2,770 tons were recovered in alloys, a total of 2,779 short tons.

Consumption.—Roughly, the consumption of antimony in the United States is indicated by the antimony produced from domestic and foreign ore, the secondary or recovered antimony, the antimony in antimonial lead, the imported antimony, and the antimony contained in imported type metal. The consumption in 1910 may be shown thus:

Consumption of antimony in the United States in 1910.

	Short tons.
Antimony from domestic and foreign ores (estimated as 60 per cent of ore)	419
Secondary or recovered antimony	2,779
Contained in antimonial lead of domestic origin	1,598
Contained in antimonial lead of foreign origin	631
Imported antimony	3,978
Contained in imported type metal	1,109
Total	10,514

Valued at 8.24 cents per pound, this total amounted to $1,732,707.20, to which is to be added the value of the imported oxide and salts, $14,201.

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BISMUTH.

By FRANK L. HESS.

Production.—In 1910 bismuth was produced as a by-product in electrolytic lead refining by the United States Refining Co., at Grasselli, Ind., and a few tons of bismuth-bearing gold ore from Leadville, Colo., had its bismuth content purchased. However, bismuth continues to be one of the few metals of which the United States can not or does not produce enough to supply its needs. As with tin, nickel, platinum, and antimony, the known deposits are not sufficient to supply the demand at figures which are reasonable when compared with the production of foreign deposits. As to arsenic, although the United States imports it in great quantities, it is not because sufficient arsenic can not be produced cheaply in this country but because the price of arsenic is so low that the cost of packing and transportation from the smelters to the seaboard is nearly equal to the cost of foreign arsenic. Bismuth, however, is always of high price when considered in the light of its uses and the facility with which it is handled metallurgically. Two principal factors enter into its cost—its scarcity and the control of the market, which is generally accredited to a foreign syndicate.

No large deposits of bismuth are known in the United States. Here and there in the mines at Leadville, Colo., bunches of ore rich in bismuth are found which when sold have payment made for their bismuth content. In 1910 R. H. Shipley, operating the Highland Mary mine, produced such ore containing 11.6 to 15.97 per cent of bismuth and amounting to several tons of the metal. Though mined for gold, the ores were more valuable for their bismuth than for their gold content.

The Comstock mine at La Plata, La Plata County, Colo., produced ore during the year which carried up to 18 per cent bismuth, with gold and silver. The ore was smelted for the precious metals contained; but if it had been sold for its bismuth content alone (18 per cent) it probably would have brought at least $185 per ton.

At Grasselli, Ind., the United States Refining Co. separated bismuth from the anode muds in its electrolytic lead refinery. The bullion refined is made mostly from the Utah lead ores smelted at the company's plant at Bingham Junction, Utah. The larger part of the lead ores carrying bismuth comes from the Tintic district, but the company buys bismuth-bearing lead, gold, and silver ores from other districts and States.

Bolivia is the principal bismuth-producing country, and from it was exported during 1910 bismuth ore amounting to 685,769 pounds,

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valued at $930,934.[1] Queensland[2] produced 47,040 pounds of bismuth ore, probably mostly native bismuth, valued at $47,244; and also 38 short tons of mixed bismuth and tungsten ore, valued at $23,671, were produced. In New South Wales[3] 14,336 pounds of bismuth metal and ore, valued at $9,752, were produced. Tasmania[4] produced 23,968 pounds of bismuth ore, valued at $5,935. The output of other countries is unavailable at this time.

Imports.—According to figures of the Bureau of Statistics, in 1910 the United States imported for consumption 198,174 pounds of bismuth, valued at $332,668.

The imports of metallic bismuth for consumption since 1904 have been as follows:

Imports for consumption of metallic bismuth into the United States, 1904–1910, inclusive, in pounds.

Year.	Quantity.	Value.
1904	185,905	$339,056
1905	148,589	318,007
1906	254,733	318,452
1907	259,881	325,015
1908	164,793	257,397
1909	183,413	286,516
1910	198,174	332,668

Prices.—During 1910, as in former years, the price of bismuth was closely governed by foreign firms. From January to May, inclusive, bismuth was quoted in the Mining World at $1.70 to $1.80 per pound; during June, July, and August at $1.95 to $2.05; and during the remainder of the year at $2.10 to $2.15 per pound.

[1] Communicated by the Pan American Union, Oct. 25, 1911.
[2] Ann. Rept. Under-Sec. Mines 1910, Brisbane, 1911, p. 19.
[3] Letter E. F. Pittman, Under-Sec., Dept. Mines, Feb. 17, 1911.
[4] Progress of the mineral industry of Tasmania, 1910 and 1911.

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SELENIUM.

By FRANK L. HESS.

In 1910 three firms—the American Smelting & Refining Co., the United States Metals Refining Co., and the Nichols Copper Co.—made a total production of selenium for the year of 10,674 pounds, valued at about $35,000, the price ranging from $3 to $5 per pound.

In the United States selenium is produced only from the anode muds in electrolytic copper refineries. The demand is not large, being practically confined to the manufacturers of red glass and red enameled ware.

In the refineries both domestic and foreign ores are used and no estimate can be made of the quantity obtained from either class of ores.

The production of selenium could be very largely increased, and probably would be, if the demand were sufficient to justify its separation.

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TUNGSTEN.

By Frank L. Hess.

GENERAL CONDITION OF TUNGSTEN INDUSTRY.

There was a better and more continuous demand for tungsten ore in 1910 than in 1909, and a better price, so that mining was encouraged and the output of the United States for the year was probably the largest ever made by any country. The production was 1,821 short tons of concentrates, carrying 60 per cent tungsten trioxide (WO_3), and was obtained from about 20,000 tons of crude ore.

The uses of tungsten are so definite and so unique that the status of the tungsten trade is becoming more firmly fixed each year. Unfortunately there is no diversity of large uses—the one use which creates the bulk of the demand at present being in metal-cutting tool steels, so that prices are dependent almost wholly upon the condition of the steel trade, and upon the price obtained, of course, rests very largely the quantity of ore mined.

Resulting from the increased interest in tungsten, development in mines and mills was carried to a point that will make future responses to market demands quicker and the production of ore greater than before.

Aside from the volume of the output, the most notable feature of the year was the number of new mills built. Four were built or equipped in the Boulder field and one in Nevada.

Arizona.—As usual, a few tons of hübnerite were obtained in Arizona from the placers 4 or 5 miles north of Dragoon, and a small quantity of scheelite was produced from the Maudina mine in the Santa Catalina Mountains southeast of Oracle and about 40 miles northeast of Tucson.

From the Williams & Pittman deposits in the Aquarius or Aquerra Range, 12 miles east of Owens on Big Sandy River, some high-grade hand-picked wolframite was shipped via Kingman.

California.—Most of the tungsten ore produced in California in 1910 came from the vicinity of Atolia. As in former years, the Atolia Mining Co. was the main producer. It worked its mines steadily during the year and its product was far in excess of the combined output of the other California operators. The company bought from William Greenwood the Cora Dee claim adjoining and on the same vein with the Goldstone, acquired from Charles Wetherbee & Co. in 1909. The Cora Dee has produced only a small quantity of ore. A small production was made from the Papoose, the oldest and at one time the richest mine of the Atolia Mining Co. Considerable unsuccessful sinking and crosscutting was done in an effort to locate other ore bodies. Sinking along the veins was prosecuted in the East Union shaft, and a thin, decomposed andesite dike was encountered, the first intrusive found in connection with these veins.

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On the Cock Robin claim of W. A. Wickard and associates, 2 miles north of Atolia, a small production was made, which was milled at the Red Dog mill of the Stanford Mining & Milling Co., at Johannesburg.

On the Sunshine claim of B. M. & T. W. Atkinson, about 3 miles northwest of Atolia, a small quantity of high-grade scheelite was mined from the outcrop of a narrow vein cutting the Randsburg schists and only 100 or 200 feet from the gold vein worked by them.

A small quantity of scheelite was taken out of the Winnie claim, which has in former years also produced a few tons of scheelite.

Christensen & Dolbear, Byrne & Kuffel, Blue & Nossar, and J. I. E. Pagh worked the gravels for both tungsten and gold in a dry gulch leading southeast past the Baltic mine. These gravels reach a depth of more than 70 feet and a layer at the bottom from a few inches to 8 feet thick carries the values. Christensen & Dolbear removed the barren upper gravels with horse scrapers. The gravel of the pay streak was milled at the Red Dog mill, and one lot of 50 tons carried combined values of about $10 per ton. The gold was very low grade, as bird shot used by hunters had worked down through the gravels and entered the amalgam with the gold, thus lowering the value of the bullion. Mr. Samuel Dolbear states in a letter dated December 15, 1910, that over 3 tons of scheelite were produced from the placers. At the close of the year the placers were being equipped with sluice boxes, settling tanks, and pumps to return the water for use again. Placer claims for tungsten mining were located over a great deal of the adjoining country.

The Atolia district shows by far the largest production of any scheelite-bearing district of the world, and in fact produces about as much as all other districts combined. The other principal localities, with the quantity of scheelite (60 per cent WO_3) produced in each in 1910, are as follows:

Principal localities producing scheelite (60 per cent WO_3) in 1910.[1]

	Short tons.
Glenorchy, New Zealand	187
Hillgrove, New South Wales	168
Moose River, Nova Scotia	83
Queensland	4

Colorado.—Colorado's output of tungsten ore was the largest in the State's history and amounted to 1,221 tons of concentrates carrying 60 per cent WO_3. The other tungsten fields of the world which made a large production in 1910 were:

	Short tons.
Queensland[2]	1,145
Portugal[3]	1,132
Argentina[4]	1,061

[1] See authorities cited under world's production.

[2] Queensland Ann. Rept. Under-Sec. Mines, 1910, Brisbane, 1911, p. 19. The figures as given are: Wolfram, 855.75 long tons; bismuth and wolfram, 34 long tons; and scheelite, 3.25 long tons. For convenience, the bismuth-wolframite mixture is treated as being half wolframite, as no figures are given to show the exact contents. The output is treated as carrying 70 per cent WO_3, the content of tungsten trioxide on which ores are understood to be bought in Australia.

The bulk of the ore is from two districts in northern Queensland, Chillagoe and Herberton, about 60 to 70 miles apart, at the base of the peninsula between the Gulf of Carpentaria and the Pacific Ocean. They are near the Pacific side. Chillagoe gave nearly two-thirds of the output.

[3] Letter from Ministerio do Fomento. The figures as given were: 947.5 tonnelidas carrying 65 per cent WO_3. The bulk of the ore is from the Panasqueira district.

[4] Information from Pan American Union. The figures supplied are as follows: "The exports in 1910 amounted to 808,566 kilos, at a value of $80,857, * * * ranging from 65–75 per cent tungsten trioxide." A percentage of 70 has been used in computing the output in 60 per cent concentrates. The district is in both San Luis and Cordoba Provinces, western Argentina.

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The four principal fields of the world are thus seen to be very close together in their output, with the Boulder field leading. As shown by the table of world's production, the next largest producing field is considerably below any of these. Six-sevenths of the Argentina output is produced by the Hansa Sociedad de Minas, which exceeds the output of any single company operating in this country, and is undoubtedly the largest output of tungsten ores made by any company up to the end of 1910.

The most prominent feature of the tungsten industry in Boulder County in 1910 was the building of mills. The Primos Mining & Milling Co. finished their new mill at a point which has been named Lakewood, about 1½ miles north of Nederland. The mill is so equipped that custom ore can be received, crushed, and sampled apart from the company's own product. For this purpose a separate crusher is provided. The ore belonging to the company passes through a Blake 9 by 15 inch crusher, thence to a 10-stamp battery, which crushes to 16 mesh. From the stamps the pulp goes to 2 Wilfley tables, and then to 6 Frue vanners. The tailings from the vanners go to a V settling tank, and the coarse tailings go to a 6 by 8 foot tube mill and are ground to 150–200 mesh. The material from the tube mill then goes to the V settling tank and from that to 5 Frue vanners with smooth belts. From the vanners the tailings pass over 3 sets of canvas. Each set contains 40 strips 4 feet wide. The first set is 40 feet long, the second 30 feet long, and the third 20 feet long. Electric power is used. The mill is so situated that the haul for all ore from the Conger and Lone Tree mines is downhill, a distinct advantage over the haul to the old mill at Cardinal, which is uphill.

The equipment of the mill at Cardinal is similar to that at Lakewood, except that it is not so large nor so convenient, for it was a small mill intended for gold and silver ores and was rebuilt for use in dressing tungsten ore. After the completion of the Lakewood mill the Cardinal mill was used to rework the accumulated tailings. These contained more than 1 per cent WO_3.

The mill of the Wolf Tongue Mining & Milling Co. at Nederland is also a rebuilt gold and silver mill. During 1910 it was overhauled, and many improvements were made. Among others was the addition of a canvas plant. As all the ores milled by the company are bought either of lessees or independent operators, the mill is so arranged that all ores are sampled. The ore is brought by wagons and is dumped on a sampling floor. The high-grade ore, carrying 30 per cent or more WO_3, goes to a 6 by 10 inch Sampson crusher and is sampled by a Bazin sampler. It is then elevated to a bin from which it is sacked and shipped. Low-grade ores are sent to the stamps, of which only 5 out of a 20-stamp battery are used. The stamps weigh 950 pounds and drop 104 times per minute with a 6-inch drop. The parent company, The Firth-Sterling Steel Co., made its own stamp shoes and dies with a higher percentage of chromium than is usually used, and obtained a very much longer life for these parts. The ore is crushed to 10 mesh and is then treated by water classifiers, 3 Wilfley tables and 1 Card table (the latter taking the fines), 3 Wilfley slimers, and 1 Monell slimer. Tailings and middlings are reground in a 3½-foot Huntington mill to pass a 60-mesh screen. This pulp is pumped to a classifier, the overflow from which goes to a Wilfley slimer and the coarse to 2 Wilfley tables. The overflow from all the concentrat-

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ing boxes goes to a cement settling tank, about 20 by 15 feet and 3 feet deep, from which the overflow runs through cocoa matting. The exceeding fineness of the slimed ferberite, and the difficulty of saving it, is shown by the fact that the tank saves about 1 per cent of the production of the mill. All tailings pass over the canvas frames. The Monell slimer, introduced during the year, is said to effect a much better saving of slimes than any other device used. The company for a time used its own water power for running the mill, but during 1910 electric power was bought from the Central Colorado Power Co.

On Beaver Creek, 2 miles south of Nederland, 2 mills were erected during the year. The Ardourel & Smith mill is on the north bank of Beaver Creek, one-half mile east of the Rollinsville road. It was finished in November and only a little work was done in 1910. Most of the work done by the mill has been on tailings from the Wolf Tongue Mining & Milling Co.'s property. The mill is equipped with two 40-ton ore bins from which a screw feed works the tailings to a ¼-inch mesh shaking screen, 14 by 48 inches. The screen is used to break up mud balls which form in the material. From the screen the pulp goes to a 3-compartment hydraulic classifier, from which the coarsest sand goes to a Wilfley table and from the other two compartments the material goes to 2 Monell slimers. The overflow goes to 4 canvas strips 4 feet wide by 20 feet long. For working ore a quartz mill with four 800-pound mullers, crushing to 24 mesh is used, but it is the owners' intention to put in stamps. The tailings upon which the mill worked are said to have run about 3 per cent WO_3. The saving was 1 ton of concentrates carrying 45 per cent WO_3 from 20 tons of tailings treated. This indicates a saving of 75 per cent. The tailings are hauled 2 miles across a hill about 450 feet high which lies between Beaver Creek and Nederland. The mill uses electricity for power.

One-half mile farther down Beaver Creek the Tungsten Mining Co. has erected a mill which has operated altogether on the dumps from workings on their property. The dumps are said to carry 3½ per cent WO_3. The ore is fed to a No. 2 Denver crusher (8 by 8 inches) and falls to a bin and thence to a quartz mill with 800-pound mullers, grinding to 18 mesh. Stamps will be installed later. From the quartz mill the material goes to a Krug screen, from which the oversize is led to a Monell concentrating table, and the fines to a hydraulic classifier from which the coarser part is sent to a Monell concentrating table and the fines to a Monell slimer. The middlings and tails from the Monell tables are re-run. The overflow from the concentrating boxes flows across cocoa matting to a small cement sump. The mill handles from 5 to 6 tons of ore per day, from which concentrates which average 50 per cent WO_3 and 30 per cent WO_3 are made in the proportion of 3 to 1. This mill also uses electricity, for which a minimum charge of $48 per month is made, with 13 mills per kilowatt hour for excess.

Another new mill, that of the Eureka Tungsten Mining & Milling Co., was fitted up in Boulder, at the mouth of Boulder Canyon, with a capacity of 20 tons per day. The company mills its own ores and also does custom work.

The Clarasdorf mill and the Eagle Rock mill were idle during the year.

During 1910 the Primos Mining & Milling Co. operated the Conger (or Boulder County) and the Lone Tree mines at Nederland,

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and other properties at Sugar Loaf, which are reported to have shown excellent ore shoots. A 1,000-foot vertical shaft was started on the Conger, on the brow of the hill a short distance northeast of the present inclined shaft. The Conger is still the premier mine of the district.

The Wolf Tongue Mining & Milling Co. still operates its mining properties through lessees and buys ores.

On the Rogers tract, under general charge of Eugene Stevens, many areas were worked by lessees.

South of Nederland lessees did some work upon the property of the Tungsten Mining, Milling & Exploration Co. Some ore was also produced from the Howell & Lightburner and the Greene & Berger properties 4 miles southeast of Nederland, just across the Gilpin County line.

Several mines along the lower part of Boulder Canyon and in the Sugar Loaf district also produced, and the Frigid Mining Co. opened a promising vein near Crisman, thus extending the producing territory to the northeast.

The buying of tungsten ores was active, and during part of the year there was considerable competition. On the 1st of September, 1910, the two principal buyers, the Primos Mining & Milling Co. and the Wolf Tongue Mining Co., put out the following schedules of prices, which are printed side by side to afford easier comparison:

Prices offered for tungsten ore at Nederland, Colo., Sept. 1, 1910.

Percentage of WO_3.	For ore delivered at Primos mill, Lakewood, Colo.[1]		For ore delivered at Wolf Tongue mill, Nederland, Colo.[2]	
	Per unit of WO_3.	Per ton of ore.	Per pound of WO_3.	Per ton of ore.
1	$4.05	$4.05	$0.15	$3.00
2	4.10	8.20	.15	6.00
3	4.15	12.45	.15	9.00
4	4.20	16.80	.15	12.00
5	4.25	21.25	.21	21.00
6	4.30	25.80	.21	25.20
7	4.35	30.45	.22	30.80
8	4.40	35.20	.22	35.20
9	4.45	40.05	.22	39.60
10	4.50	45.00	.225	45.00
11	4.55	50.05	.23	50.60
12	4.60	55.20	.23	55.20
13	4.65	60.45	.23	59.80
14	4.70	65.80	.235	65.80
15	4.75	70.25	.235	70.50
16	4.80	75.80	.235	75.20
17	4.85	82.45	.245	83.30
18	4.90	88.20	.245	88.20
19	4.95	94.05	.245	93.10
20	5.00	100.00	.25	100.00
21	5.05	106.05	.255	107.10
22	5.10	112.20	.255	112.20
23	5.15	118.45	.255	117.30
24	5.20	124.80	.26	124.80
25	5.25	131.25	.265	132.50
26	5.30	137.80	.265	137.80
27	5.35	144.45	.265	143.10
28	5.40	151.20	.27	151.20
29	5.45	158.05	.275	159.50
30	5.50	165.00	.275	165.00
31	5.55	172.05	.275	170.50
32	5.60	179.20	.28	179.20

[1] Prices subject to change without notice. Ore in small lots or less than $50 in value subject to a charge of $5 for sampling and assaying.

[2] Subject to change without notice. On lots under 2,000 pounds assaying less than 30 per cent, a charge of $4 will be made. On lots under 500 pounds assaying 30 per cent and above, a charge of $3 will be made. Otherwise no charge will be made for milling and assaying.

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Prices offered for tungsten ore in Colorado Sept. 1, 1910—Continued.

Percentage of WO_3.	For ore delivered at Primos mill, Lakewood, Colo.		For ore delivered at Wolf Tongue mill, Nederland, Colo.	
	Per unit of WO_3.	Per ton of ore.	Per pound of WO_3.	Per ton of ore.
33	$5.65	$186.45	$0.285	$188.10
34	5.70	193.80	.285	193.80
35	5.75	201.25	.285	199.50
36	5.80	208.80	.29	208.80
37	5.85	216.45	.295	218.30
38	5.90	224.20	.295	223.20
39	5.95	232.45	.297	231.66
40	6.00	240.00	.30	240.00
41	6.05	248.05	.305	250.00
42	6.10	256.20	.31	260.40
43	6.15	264.45	.315	270.90
44	6.20	272.80	.32	281.60
45	6.25	281.25	.325	292.50
46	6.30	289.80	.33	303.00
47	6.35	298.45	.335	314.90
48	6.40	307.20	.34	326.40
49	6.45	316.05	.345	338.10
50	6.50	325.00	.35	350.00
51	6.55	334.05	.355	362.10
52	6.60	343.20	.36	374.40
53	6.65	352.45	.365	386.90
54	6.70	361.80	.37	399.60
55	6.75	371.25	.375	412.50
56	6.80	380.80	.38	425.60
57	6.85	390.45	.385	438.90
58	6.90	400.20	.39	452.40
59	6.95	410.05	.395	466.10
60	7.00	420.00	.40	480.00

Besides the two companies mentioned several other firms and persons also bought some ore during the year.

In Chaffee County Frank P. White, of Salida, uncovered a small lot of scheelite 3½ miles east of Salida. It has not been found in commercially valuable quantities.

Some notice was taken of the hübnerite deposits between Silverton and Gladstone in Ouray County, but no production was made. A few tons of tungsten ore were taken out of these veins some years ago.

Idaho.—A company took steps toward working hübnerite-bearing ores on the Ima Mining & Milling Co.'s claims on Patterson Creek in the Blue Wing district, 15 miles from Goldburg. Hübnerite occurs in quartz veins with dark sphalerite, pyrite, chalcopyrite, galena, and fluorite. It is difficult to distinguish between the hübnerite and the sphalerite. Attempts have been made to work the veins for their gold content, but the tenor is too low. The nearest railroad point, Leadore or Junction, is between 20 and 25 miles eastward across the mountains, but a road had not been cut through during the year, so that freight had to be hauled to and from Mackay, on the Oregon Short Line, 60 miles south.

Montana.—No commercial production of tungsten ores is known to have been made during the year.

A discovery of wolframite was announced in the technical press as having been made in Goodrich Gulch, near Twin Bridges, but specimens sent to the Survey from the supposed find were hematite and carried no tungsten.

Light-colored hübnerite, similar to that in the Birdie mine at Butte, was found on the west slope of Sugar Loaf Mountain, Powell

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County, at the head of Race Track Creek, but did not prove of commercial value. Mr. Benjamin Daniels, of Anaconda, reports that he has discovered hübnerite at several other places in the same range and that it can be panned in small quantity from the gravels of the streams in that area.

The scheelite deposits near Jardine, in Park County, were not worked during 1910.

Nevada.—On the hübnerite deposits in the Snake Range, 12 miles south of Osceola and 45 miles southeast of Ely, considerable development work was done during the year by the United States Tungsten Corporation, formerly the Hübnerite Tungsten Co., and a mill was erected. The mill is equipped with a crusher, rolls, screen, classifiers, Wilfley tables, and Isbell vanners, and has a nominal capacity of 50 tons per 24 hours. Water power by which the mill can be operated part of the year is furnished by a ditch about 6,000 feet long, which brings water from Williams Creek and gives a head of 600 feet. The ditch also furnishes water for concentrating. A steam plant to furnish power when water power is not available has been erected.

Near Regan hübnerite deposits were discovered during the year by C. G. Sims and Casten Olsen. The deposits are about the middle of the Kern Range, 6 miles from the Utah line and 50 miles north of Osceola. The nearest shipping point is McGill on the Nevada Northern Railroad, 45 miles distant. Veins are said to have been found through a length of 2 miles and a width of 1 mile. O. A. Turner took an option on 12 claims and was prospecting them at the close of the year.

At Browns, Humboldt County, the Atolia Mining Co. did some further prospecting work, but no production was made.

Nothing beyond assessment work is known to have been done on other tungsten deposits of the State.

Washington.—The only tungsten mining known to have been done in Washington during 1910 was in Stevens County.

Ten miles south of Daisy, G. C. & W. L. Stockwell have located, near Bissell, claims known as the Black Horse group covering wolframite-bearing veins. The deposits are 5 miles from the Columbia River and 14 miles from a railroad. They are 15 miles north of the Germania Mining Co.'s deposit at Cedar Canyon. The veins are said to carry gold, silver, pyrite, tourmaline, and molybdenite in small quantities. Nothing but prospect work had been done up to the close of the season.

At Cedar Canyon the Germania Mining Co. operated its mine and mill the larger part of the year on a wolframite ore carrying some bismuth. The mill had a capacity of 25 to 30 tons per day and was equipped with a Blake crusher, rolls, screen, both Harz and Richards pulsator jigs, Wilfley tables, and Card tables. The mine was idle from the latter part of August to the middle of November. The concentrates were shipped to Germany.

The Tungsten King and other claims of the Deer Park Mining Co. are located 10 miles north and east of Deer Park and somewhat closer to Loon Lake. The company is working hübnerite-bearing quartz veins, which also carry some gold, silver, bismuth, and fluorite. A 440-foot adit was completed in 1910 and a shaft was begun. A concentrating plant with a capacity for treating 15 tons of ore per day

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was erected, and plans were made to increase its capacity to 40 tons per day. A small quantity of concentrates were shipped.

Adjoining the Tungsten King claim on the north is the Blue Grouse Mining Co.'s property, and north of that the Empire Tungsten Mining Co.'s claims. All three properties are on Blue Grouse Mountain.

On the Blue Grouse claim an adit was begun to cut the vein 200 or more feet below the outcrop. Some high-grade ore was shipped during the year.

A plan has been developed to combine the three properties last named, and perhaps others, the controlling company to be known as the Tungsten Consolidated Companies.

Other States.—There are also tungsten deposits in the Black Hills of South Dakota and in New Mexico. A few hundred pounds of wolframite were shipped from the Black Hills, but no production is known to have been made in New Mexico in 1910.

PRODUCTION.

The production of domestic tungsten ore in 1910 amounted to 1,821 short tons, valued at $832,992.

The production of tungsten ore in the United States has been recorded only since 1900; before that time it was insignificant. As obtained by the United States Geological Survey the figures are as follows:

Production of concentrated tungsten ores in the United States, 1900–1910, in short tons.[1]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	46	$11,040	1906	928	$348,867
1901	179	27,720	1907	1,640	890,048
1902	184	34,040	1908	671	229,955
1903	292	43,639	1909	1,619	614,370
1904	740	184,000	1910	1,821	832,992
1905	803	268,676			

[1] The production of tungsten ores in this country from year to year can be fairly compared in this table only since and beginning with 1906, as before that date no effort had been made to reduce the ores to a common basis of concentration. Since 1906 the ores have been, as far as possible, reduced to an equivalent of ore carrying 60 per cent tungsten trioxide (WO_3), which is the ordinary commercial basis in the United States.

PRICES.

During 1910 prices ranged from $6.50 to $8.50 per unit for ore carrying 60 per cent or more of tungsten trioxide. Leaner ores brought a lower price per unit (see price list). A little ore was sold as high as $9 or more per unit to buyers having special needs.

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WORLD'S PRODUCTION.

The world's production of tungsten ore, 1905–1910, by countries, estimated as far as possible in short tons of concentrates containing 60 per cent of tungsten trioxide.

Country.	1905	1906	1907	1908	1909	1910
Africa: South Africa	.....	9	211	40	16	(a)
Asia:						
Federated Malay States	.....	151	89	83	99	[b] 105
French Indo-China	.....	.....	.....	.....	.....	[c] 19
India	.....	.....	.....	.....	7	[d] 23
Siam	.....	.....	10	.....	.....	.....
Australia:						
New South Wales	251	270	451	269	431	[e] 413
Northern Territory	71	230	177	40	49	[f] 78
Queensland	1,582	865	703	516	679	[g] 1,145
Tasmania	36	22	46	5	20	[h] 75
Victoria	.....	.....	.....	3	15	[i] 31
Western Australia	.....	.....	1	.....	6	[j] 47
East Indies:						
Billiton	.....	.....	4	11	[k] 12	[k] 21
Singkep	.....	.....	1	14	[l] 12	[k] 12
Europe:						
Austria	65	63	50	44	43	[m] 54
England	193	304	361	261	421	[n] 307
France	28	20	67	124	[o] 55	.....
German Empire (Saxony)	42	57	68	46	[p] 106	[q] 105
Italy	36	28	18	.....	.....	(a)
Portugal	320	629	702	684	609	[r] 1,132
Spain	413	222	303	249	[s] 142	.....
Oceania: New Zealand	64	121	153	87	78	[t] 187
North America:						
Nova Scotia	.....	.....	.....	.....	.....	[u] 83
United States	803	928	1,640	671	1,619	1,821
South America:						
Argentina	.....	326	507	548	900	[v] 1,061
Bolivia	75	75	500	187	168	[v] 232
Brazil	.....	.....	.....	16	.....	.....
Total	3,979	4,320	6,062	3,893	5,487	6,951

[a] So far as can be learned, no tungsten ores were produced in South Africa or Italy during 1910.
[b] Min. Jour., London, vol. 94, July 22, 1911, p. 745.
[c] Carlisle, — — (Consul), Trade and Commerce of French Indo-China for the year 1909: Dipl. and Cons. Repts., London, No. 4596, Ann. Ser. 1910, p. 16. From mines near Caobang, Tonkin.
[d] Letter from H. H. Hayden, Director Geological Survey of India, Aug. 16, 1911.
[e] Letter from E. F. Pittman, Under Sec. Mines, Feb. 17, 1911. As given, the figures were: Scheelite 150.6 long tons; wolfram, 165.67 long tons. For purposes of conversion to a 60 per cent basis the ores have been considered to carry 70 per cent WO_3, which is the content on which prices are based in Australia.
[f] Letter from Atlee Hunt, Sec. Dept. External Affairs, Commonwealth of Australia, Mar. 4, 1911. Heretofore the figures as given in this table have been credited to "South Australia and Northern Territory," but it is thought that all the tungsten ores have come from Northern Territory, which has been governed by South Australia.
[g] See footnote, p. 4.
[h] Progress Min. Ind., Tasmania, Hobart, 1910 and 1911 (quarterly).
[i] Letter from I. Cohen for Sec. Mines, Apr. 21, 1911. Wolframite.
[j] Letter from A. Gibb Maitland, Government geologist, May 26, 1911. Wolframite.
[k] Letter from Nederlandsche Handels-Maatschappij, dated Oct. 27, 1911. The Billiton figures for 1910 are from the end of January, 1910, to the end of January, 1911. The figures for 1910 given for Singkep are from the end of June, 1909, to the end of June, 1910.
[l] Mines and Quarries, Gen. Repts. with Statistics for 1910, pt. 4, Colonial and Foreign Statistics, Home Office, London, 1911, p. 386.
[m] Statistik des Bergbaues in Österreich für 1910, No. 1, Vienna, 1911, p. 105.
[n] Mines and Quarries, etc., 1910, pt. 1, 1911, pp. 16–17, 20–21. Wolframite.
[o] Statistique de l'industrie minérale et des appareils à vapeur en France et en Algerie pour l'année 1909, p. 32. Wolframite.
[p] Jahrbuch für das Berg- und Hüttenwesen im Königreiche Sachsen, Jahrgang 1910, Freiberg, 1910, p. B65. Wolframite.
[q] Min. Jour., London, vol. 95, Nov. 25, 1911, p. 1140. Wolframite.
[r] Figures received from the Ministerio do Fomento, September, 1911, following a letter of previous date. The figures as given were: Wolfram, 947.5 toneladas, 65 per cent WO_3.
[s] Estadistica minera de España, Año 1909, Madrid, 1911, pp. 22–23. Wolframite.
[t] Letter from H. I. H. Blow, Under-Sec., Mines Dept., New Zealand, Feb. 20, 1911. Exports of scheelite. The figures given were 143 long tons. The ore is thought to have run about 70 per cent WO_3.
[u] McLeish, John, Canadian Min. Jour., Toronto, vol. 32, Apr. 15, 1911, p. 241.
[v] Communicated by the Pan American Union, Sept. 27, 1911. The figures as given were 1,911,926 kilos, ranging from 65 to 75 per cent WO_3, from Argentina and 210,061 kilos from Bolivia.

The figures for 1910 are complete enough to be fairly satisfactory, and a comparatively close estimate can be made. The countries which have not made their statistics known at this writing produced

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a total of 197 tons of ore in 1909. On the supposition that they marketed a quantity of ore in 1910 equal to that in 1909, the total 1910 output would be about 7,150 tons. It seems probable that enough ore has escaped notice to make the total fully 7,500 short tons, carrying 60 per cent WO_3.

From a comparison of the figures given in the table it will be seen that in 1910 the United States was the largest producer of tungsten ores (1,821 short tons), though the lead over Australia was slight, the total output for the Commonwealth being 1,789 short tons, calculated to a 60 per cent basis as nearly as the data will allow.

USES.

No important new uses for tungsten came to the notice of the Survey during the year, but such wonderful improvements were made in the manufacture of tungsten incandescent electric-lamp filaments as to make their use amount almost to a new one. The General Electric Co. so developed the drawing of tungsten into fine wire that, as now made, it is about as strong as steel wire. This has made possible not only the shipping of tungsten lamps with a very small loss from breakage of the filament, but railroad trains and automobiles now carry tungsten incandescent electric lamps. To railroads this means a very great saving in electric power, with a consequent lessening of the weight of storage batteries used or a lengthening of their period of service per charge; or it means that a smaller dynamo will light the train. It also furnishes a light much more comfortable for use to the traveling public. Some roads kept a low-voltage current running through the lamps when not lighted in order to make the filament tougher and so resist shock better, but this practice has probably been discontinued with the improvement of the filament.

The toughening of the filament has also made more practicable lamps of large candlepower. Tungsten lamps are now used almost everywhere that electric lighting is used.

Siemens & Halske, A.-G., of Berlin, Germany, have taken out foreign patents upon a process for increasing the ductility of tungsten by adding sufficient nickel [1] to make from 8 to 20 per cent of the resulting alloy. The patent specifications claim that if electric-lamp filaments are to be made, the nickel, which lowers the melting point, may be so far removed by slowly heating in a vacuum that the filament will give no trouble when in use.

Another use of tungsten which has increased greatly is in the making of steels for permanent magnets. The steel is used for magnetos, speed indicators, and similar instruments.

The value of tungsten as a mineral product is almost insignificant when compared with iron, copper, or the other principal metals, but the saving effected through its use is marvelous. Dr. W. R. Whitney, chief of the research laboratory of the General Electric Co., in a paper delivered before the Technology Congress at the Massachusetts Institute of Technology in the spring of 1911, stated:

> A broader but perhaps less accurate impression of changes recently produced may be gained by considering the economy now possible on the basis of our present incandescent lamp purchases in this country and that which would have resulted if the

[1] Min. Jour., London, vol. 88, Mar. 5, 1910, p. xiii.

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lamps of only 10 years ago were used in their stead. On the assumption that the present rate of lamp consumption is equivalent to about eighty million 25-watt tungsten lamps per year, and on the basis of 1¼ watts per candlepower as against 3.1 of the earlier lamps and of charging power at 10 cents per kilowatt hour, we get as a result a saving of $240,000,000 per year, or two-thirds million per day. Naturally, this is a saving which is to be distributed among producers, consumers, and others, but illustrates very well the possibilities.

The saving in machine and other metal-cutting shops probably has been very much larger. Mr. Elwood Haynes, president of the Haynes Automobile Co., stated in a personal communication that his company would be compelled to add $200 to the selling price of each automobile produced should the firm have to use carbon-steel tools in place of the tungsten-steel tools which they now employ. The advent of tungsten-steel tools has compelled the redesigning and rebuilding of metal-cutting lathes, as on a conservative estimate lathes equipped with such tools can be made to cut four times as fast as they can with carbon-steel tools, which means that four times as much work can be done by each lathe with the attendant labor. It is probable that the saving thus effected in the United States alone amounts to hundreds of millions of dollars per year.

IMPORTS AND EXPORTS.

Most of the tungsten ore produced in this country was used here, but a small quantity was exported. The imports were comparatively large, not only of ore but of metal and ferrotungsten. The tonnage of ore imported is not available. The value was given as $344,979. As the average price of ore in the United States was about $7.50 per unit, it seems probable that the price of the foreign imported ore must have been about $6.50 to $6.75 per unit, since it would have to pay a tariff of 10 per cent and it must have offered some advantage in price over the American ore. If $6.75 per unit be taken as a basis, then an equivalent of about 852 tons of 60 per cent ore was imported.

Ferrotungsten and tungsten metal weighing 528 tons and valued at $678,534 were imported. It is undesignated in the customs returns except as "tungsten or wolfram metal and ferrotungsten—valued at more than $200 per ton."

CONSUMPTION.

Only an approximation of the tungsten consumed in this country can be given. The consumption in 1910 was as is shown in the following table:

Consumption of tungsten, ferrotungsten, and tungsten ore in the United States in 1910, in short tons.

	Quantity.	Value.
Ore produced (60 per cent WO_3)	1,821	$807,307
Ore imported	852	344,979
Ore exported	2,673	1,152,286
	94	47,940
Total ore	2,579	1,104,346
Tungsten and ferrotungsten imported	528	678,534
Total value of ore and metal used	.....	1,782,880

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OCCURRENCES OF TUNGSTEN MINERALS IN THE UNITED STATES.

ARIZONA.

COCHISE COUNTY.

Dragoon.—Hubnerite accompanied by small quantities of scheelite occurs with fluorite in quartz veins cutting granite, and in placers derived from the veins. Most of the production has been from the placers.

Teviston (Bowie).—Scheelite occurs in veins with pyrite and chalcopyrite in the Chiracahua Mountains.[1]

Whetstone Mountains.—Twelve miles south and a little east of Benson wolframite occurs disseminated in granite and in quartz with a very little scheelite. A few tons of ore have been produced.

MARICOPA COUNTY.

A wolframite-bearing vein from 1 to 2 inches wide occurs on the New York claim in the White Picacho district. It is not of commercial importance.

MOHAVE COUNTY.

Greenwood district.—Wolframite is found in quartz veins cutting granitic rocks in the Aquarius (Aquerra) Range, 12 miles from Owens on Big Sandy River. Small quantities of hand-picked ore have been shipped for several years. The haul to Kingman, on the Santa Fe Railway, is more than 60 miles.

PIMA COUNTY.

Arivaca.—Hübnerite accompanied by wolframite, a very little scheelite, and, in the oxidized portion, tungstite,[2] occurs in quartz veins in the Gigas Mountains. A few tons of hand-picked ore have been produced at various times. The haul to the Southern Pacific railroad at Tucson, the nearest shipping point, is more than 70 miles.

Hualpai Mountains.—Narrow quartz veins carrying wolframite and gray scheelite with pyrite and fluorite cut sericite schists, on the west side of the Hualpai Mountains, 18 miles northeast of Yucca. A small quantity of ore has been shipped.

PINAL COUNTY.

Old Hat district.—Scheelite occurs with gold and silver ores in the Maudina mine. Some production has been made. Blake[3] notes the occurrence of wolframite in the same district.

SANTA CRUZ COUNTY.

Calabasas.—Three miles southeast of Calabasas, quartz veins from a few inches to 2 feet wide, carrying wolframite and a very small quantity of scheelite, cut granodiorite. A little ore has been taken out during the course of prospecting.

YAVAPAI COUNTY.

Tip Top district, Columbia.—Wolframite is found with silver ores in the Tip Top mine near Columbia.

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[1] Blake, W. P., Minerals of Arizona, their occurrence and association, with notes on their composition. A report to the Hon. J. H. Kibbey, Governor of Arizona, Tucson, 1909, p. 49.
[2] Blake, W. P., op. cit., p. 57.
[3] Op. cit., p. 60.

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CALIFORNIA.

MADERA COUNTY (?).

Raymond.—Wolframite has been found in small quantity in a copper-stained quartz vein cutting andalusite schist, 9 miles north of Raymond. This deposit may be across the line of Mariposa County.

NEVADA COUNTY.

Grass Valley.—Scheelite is said to have occurred in considerable quantities in the foot wall of a gold mine on Howard Hill.[1]

SAN BERNARDINO COUNTY.

Atolia district.—By far the largest scheelite deposits known in the United States occur at Atolia. The veins are composed of fine granular quartz, more or less ferriferous calcite, and scheelite, and cut an acidic granodiorite. The field extends northwest to Randsburg, a distance of about 4 miles, over an area of schists which are cut by narrow quartz veins carrying scheelite. Some of the gold-bearing veins carry scheelite. The Atolia deposits produce steadily when the market price is attractive to the mine owners. The rest of the field produces a little ore spasmodically. Scheelite placers have been worked at Atolia and about halfway between Atolia and Randsburg. At Atolia the placers were residual. The other placers are ancient stream gravels.

Avawatz Mountains.—Scheelite in small quantity occurs with granitic rocks in the Avawatz Mountains, 35 miles northeast of Silver Spring, on the Tonopah & Tidewater Railroad, and 8 or 10 miles south of the south end of Death Valley. There has been no production.

Clark Mountains.—In the Clark Mountains, 16 miles northwest of Ivanpah and 24 miles northeast of Cima, both wolframite and scheelite, accompanied by small quantities of cinnabar and antimony minerals, occur in quartz calcite veins cutting granitoid rocks. The scheelite is gray and in places fills the spaces between combs of wolframite, which is the predominating tungsten mineral.

Victorville.—Gordon Surr[2] has described an economically unimportant occurrence of scheelite 15 miles northwest of Victorville. The scheelite with copper minerals is in altered limestone at its contact with schists. Close by, pegmatite dikes cut the schists.

Von Trigger.—Hübnerite with copper minerals occurs in comby quartz veins which cut granitoid rocks 7 or 8 miles east of Von Trigger. No production has been reported.

KERN COUNTY.

Paris.—On Indian Creek in the Amalie district, 15 miles east of Caliente, scheelite is found with antimony and lead in a gold and silver bearing quartz vein at the contact of limestone and schist. Some production has been made.

White River.—Cuproscheelite is reported by Hanks[3] as occurring 12 miles east of White River post office. It was evidently in small quantity.

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[1] Hanks, Henry G., The minerals of California: Fourth Ann. Rept. State Mineralogist, Sacramento, 1884, p. 353.
[2] Surr, Gordon, Tungsten at Victorville: Am. Min. Rev., Los Angeles, vol. 24, July 11, 1908, p. 89.
[3] Hanks, Henry G, The minerals of California: Fourth Ann. Rept. State Mineralogist, Sacramento, 1884, p. 159.

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COLORADO.

BOULDER COUNTY.

Grand Island and other districts (Nederland).—Nederland is the mining center of the Boulder County tungsten field which extends in a belt 2 or 3 miles wide from the northern edge of Gilpin County, between 12 and 15 miles northeast, to Crisman. It is the most productive tungsten field in the world. The ore is ferberite with a relatively small quantity of quartz occurring in brecciated veins cutting granite and gneiss. The ferberite is accompanied in a few places by scheelite, adularia, apatite, pyrite, gold, silver, and tellurium.

Ward.—At Ward, about 10 miles north of Nederland, are small deposits of ferberite which up to this time have not been productive. These deposits are several miles northwest of the main belt, but are probably genetically connected with it. The ferberite occurs with pyrite, chalcopyrite, gold and silver.

CHAFFEE COUNTY.

Salida.—Scheelite is found in small quantity with copper minerals about 3½ miles east of Salida.

GILPIN COUNTY.

Rollinsville.—Ferberite is mined about a mile north of Rollinsville in brecciated veins cutting pegmatite. This deposit is part of the Boulder County field. (See reference under Boulder County.)

LAKE COUNTY.

Golden Queen mine.—Dana [1] states that scheelite occurs "at the Golden Queen mine, Lake County, Colo.," but the writer has not been able to confirm the statement.

OURAY COUNTY.

Uncompahgre district, Ouray.—Hübnerite has been found in the Royal Albert vein [2] with gold and silver.

SAN JUAN COUNTY.

Silverton.—Hübnerite occurs in many of the quartz veins mined for gold, which cut rhyolites and andesites. The deposits lie between Silverton and Gladstone.[3] A few tons of ore have been produced.

CONNECTICUT.

FAIRFIELD COUNTY.

Trumbull.—Scheelite and wolframite (which has replaced scheelite crystals) have been mined from metamorphosed limestone intruded by pegmatite dikes. The deposits have not been worked for a number of years.

IDAHO.

IDAHO COUNTY.

Warren.—Dana [1] states that scheelite occurs "with gold at the Charity mine, Warren, Idaho."

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[1] Dana, J. D. and E. S., System of mineralogy, 6th ed., New York, 1909, p. 988.
[2] Hillebrand, W. F., Miscellaneous mineral notes: Bull. U. S. Geol. Survey No. 20, 1885, p. 96.
[3] Prosser, W. C., Tungsten in San Juan County, Colo.: Eng. and Min. Jour., vol. 90, Aug. 13, 1910, p. 320, 1 fig.

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LEMHI COUNTY.

Patterson Creek.—Hübnerite is found in the Blue Wing district on Patterson Creek, Lemhi County, 15 miles from Goldburg, in several of the quartz veins that have been prospected for gold. The district is one from which production will probably be made, but it is a long distance from a railroad. Mackay, the nearest shipping point, is 60 miles south at the end of a branch of the Oregon Short Line.

SHOSHONE COUNTY.

Murray.—Scheelite has been found with pyrite and galena in gold quartz veins cutting slates. A few tons of hand-cobbed ore have been sold.

MAINE.

HANCOCK COUNTY.

Blue Hill Bay.—The occurrence of wolframite on the Camdage farm, Blue Hill Bay, is noted by Dana.[1]

WASHINGTON COUNTY.

Cherryfield.—A little scheelite has been found on Catherines Hill, about 9 miles north of Cherryfield.

MASSACHUSETTS.

HAMPSHIRE COUNTY.

Chesterfield.—Scheelite is noted by C. U. Shepard [2] as occurring in albite at Chesterfield.

Southampton.—Stolzite from the Mahan lead mine, Southampton, was noted by C. U. Shepard,[3] and later by B. K. Emerson.[4]

MISSOURI

MADISON COUNTY.

Silvermine.—Wolframite has been described by Haworth [5] as occurring 8 miles west of Fredericktown at Silvermine, in a quartz vein carrying argentiferous galena.

MONTANA.

GRANITE COUNTY.

Philipsburg.—Hillebrand [6] quotes Richard Pearce as saying that hübnerite was found in a mine near Philipsburg.

MADISON COUNTY.

Potosi district.—In the Potosi district, 8 miles southwest of Pony, translucent hübnerite occurs as fine needles in quartz veins cutting granite. The veins were mined for silver.

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[1] Op. cit., p. 985.
[2] Shepard, C. U., Mineralogical notes: Am. Jour. Sci., 2d ser., vol. 37, 1864, p. 407.
[3] Shepard, C. U., On scheelitin at the Southampton lead mine, Massachusetts, and uwarowite at Wood's chrome mine, Texas, Pa.: Am. Jour. Sci., 2d ser., vol. 41, 1866, pp. 215–216.
[4] Emerson, B. K., A mineralogical lexicon of Franklin, Hampshire, and Hampden counties, Mass.: Bull. U. S. Geol. Survey No. 126, 1895, pp. 163–164.
[5] Haworth, Erasmus, A contribution to the Archean geology of Missouri: Am. Geologist, Minneapolis, vol. 1, 1888, pp. 294–295.
[6] Hillebrand, W. F., Miscellaneous mineral notes: Bull. U. S. Geol. Survey No. 20, 1885, p. 96.

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PARK COUNTY.

Sheepeater district, Jardine.—Scheelite has been mined and shipped from gold-bearing quartz veins in the Sheepeater district at Jardine.

POWELL COUNTY.

Sugar Loaf Mountain.—Hübnerite has been found in a quartz vein at the head of Race Track Creek on Sugar Loaf Mountain, a few miles from Daniels. It has been found in less quantity at other points along the range of which Sugar Loaf Mountain is a member, and in the stream gravels of the locality.

SILVER BOW COUNTY.

Butte.—Hübnerite occurs sparingly in the copper veins and in larger quantity in the silver veins 2 miles east of Butte. A few tons of ore have been shipped from the latter locality.

NEVADA.

ESMERALDA COUNTY.

Redlich.—Rich hübnerite float was found, but had not been traced to its source during 1910.

Sylvania Mountains.—Near stake 80 of the California-Nevada boundary, hübnerite occurs with fluorite in a copper-stained vein cutting a granitic rock. The deposit is 6 miles from a poor water supply and about 65 miles from a railroad.

HUMBOLDT COUNTY.

Browns.—Two miles east of Browns, a station on the Southern Pacific Railroad, scheelite occurs in a contact metamorphic deposit in limestone next to an intrusion of granite. Some ore has been shipped.

New Goldfields district, Rebel Creek.—Scheelite occurs in quartz veins with pyrite, gold, and silver, in the Warren Mining & Milling Co.'s mine, 14 miles northeast of Rebel Creek post office. One specimen received is reddish brown, resembling garnet in appearance. Another is yellow and is probably stained with tungstic ocher. There has been no production.

Gold Run district.—On the east side of the Sonoma Range, 15 miles south of Golconda, hübnerite occurs in a quartz vein with gold and silver bearing galena. There has been no production of tungsten, but the vein has been worked for lead and silver.

NYE COUNTY.

Atwood.—Specimens of hübnerite have been sent to the United States Geological Survey from Atwood. (See below under Goldyke.)

Mammoth district, Ellsworth.—Hübnerite was described as a mineral species from specimens found in this district. Hübnerite with a little scheelite occurs in veins formerly worked for gold and silver.

Goldyke.—Hübnerite and scheelite have been sent to the United States Geological Survey from Goldyke.

The specimens of hübnerite from Goldyke and Atwood are very similar to those received from Ellsworth. As Goldyke and Atwood are close to Ellsworth, it seems possible that all specimens may have come from the same deposit.

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Oak Spring.—One and one-half miles south of Oak Spring, and about 65 miles north-northeast of Johnnie siding, a small quantity of scheelite, with powellite (calcium molybdate) and molybdenite, has been found in a narrow vein cutting limestone.

Round Mountain.—Hübnerite occurs in quartz veins at Round Mountain. A small production of high-grade ore has been made.

Tonopah.—Hübnerite in delicate flat crystals and small masses occurs in the lower levels of the gold-silver veins at Tonopah. None is known to have been produced commercially.

WHITE PINE COUNTY.

Osceola.—Twelve miles south of Osceola, hübnerite, with a little scheelite, pyrite, chalcopyrite, fluorite, and white mica, occurs in quartz veins cutting granite. Much work has been done on the deposits, and some ore has been shipped. Ely, 45 miles northwest, is the nearest railroad point.

Regan.—Hübnerite has been found in veins cutting granitic country rock at Regan in the Red Hills near the Utah line, about 50 miles north and a little east of Osceola and 50 miles southeast of Currie on the Nevada Northern Railroad.

NEW MEXICO.

GRANT COUNTY.

Victorio district, Gage.—Some wolframite has been shipped from the Victorio district, 4 miles south of Gage. The mineral occurs in a quartz vein carrying a little lead and cutting limestone.

Hachita.—Scheelite is reported near Hachita in small quantity in copper deposits which carry some gold and silver. Shipments[1] of hübnerite are stated to have been made from Separ in 1895 and 1896, but the ore is said to have come from Hachita.[2]

LINCOLN COUNTY.

White Oak.—Some hübnerite has been shipped from gold-bearing quartz-pyrite veins which cut monzonite and shales.

SAN MIGUEL COUNTY.

Hermit Peak.—A little scheelite with a smaller quantity of ferberite has been found on the east end of Hermit Peak, 18 miles northwest of Las Vegas. The deposit is commercially unimportant.

SOCORRO COUNTY.

San Andreas district.—In the San Andreas district, 37 miles west of Tularosa and 4 miles north of the Dona Ana County line, scheelite occurs with bismuth and copper minerals and quartz in a metamorphosed impure sandstone.

NORTH CAROLINA.

CABARRUS COUNTY.

Cosby mine.—Wolframite in laminated masses with cuproscheelite and scheelite is stated by Frederick A. Genth[3] to occur at the Cosby mine.

Cullen's mine.—Scheelite is said[3] to occur with quartz and gold-bearing pyrite at Cullen's mine.

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[1] Blake, W. P., Min. Ind. 1898 (1899), New York and London, p. 722.
[2] J. T. Mahoney, postmaster, Separ, N. Mex., Letter dated Oct. 13, 1911.
[3] Genth, F. A., The minerals of North Carolina: Bull. U. S. Geol. Survey No. 74, 1891, p. 80.

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Flowe mine.—Genth[1] states that wolframite coated with "a rhombic tungstate of lime" occurs in barite at the Flowe mine.

DAVIDSON COUNTY.

Silver Hill.—According to Genth[2] stolzite was found in a lump of quartz associated with sphalerite at Silver Hill.

Other occurrences.—The same authority quotes General Clingman as saying that wolframite is frequently found in Rutherford and Burke counties.

None of the North Carolina occurrences are of more than mineralogical interest.

OREGON.

BAKER COUNTY.

Virtue district, Baker City.—Scheelite occurs in the gold veins of the Virtue district,[3] but it is of no commercial importance.

PENNSYLVANIA.

ADAMS COUNTY.

G. H. Williams[4] states that scheelite in minute masses forms the centers of what were probably spherulites in an ancient rhyolite. Needles of piedmontite extend into the scheelite.

SOUTH DAKOTA.

LAWRENCE COUNTY.

Lead.—Wolframite is found at Lead with gold and other minerals as impregnation deposits in an altered sandy dolomite. Some ore has been shipped.

Tinton.—Scheelite, and probably wolframite, is found in the Bear Gulch and other placers near Tinton with gold and cassiterite. The tin and possibly the tungsten minerals come from pegmatite dikes.

PENNINGTON COUNTY.

Hill City.—Wolframite grading into ferberite occurs in quartz veins and pegmatite dikes at Hill City. There has been a small production.

Keystone.—Deposits similar to those mentioned as occurring at Hill City continue on eastward to the vicinity of Keystone. No production is known to have been made from this part of the field.

TEXAS.

EL PASO COUNTY.

El Paso.—Wolframite is found in small quantities with tourmaline and quartz in the tin deposits 12 miles north of El Paso, on the east side of the Franklin Mountains. The tin-bearing veins cut granite.

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[1] Op. cit., p. 80.
[2] Idem.
[3] Lindgren, Waldemar, The gold belt of the Blue Mountains of Oregon: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 2, 1901, p. 644.
[4] Piedmontite and scheelite from the ancient rhyolite of South Mountain, Pennsylvania: Am. Jour. Sci., New Haven, 3d ser., vol. 46, 1896, pp. 50–57.

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LLANO COUNTY.

The occurrence of wolframite in Llano County is reported by T. B. Comstock.[1] The locality is indefinite.

UTAH.

TOOELE COUNTY.

Clifton district.—At the north end of the Deep Creek Mountains, 10 miles east of the Nevada line and 50 miles south of Wendover on the Western Pacific railroad, scheelite, with calcite, chalcopyrite, and small crystals of apatite, occurs in veins cutting an igneous rock.

VIRGINIA.

ROCKBRIDGE COUNTY.

Irish Creek.—Wolframite occurs with cassiterite in quartz veins cutting granite. The quantity present is probably small.

WASHINGTON.

OKANOGAN COUNTY.

Oroville.—A black tungsten mineral which may be ferberite occurs in quartz veins.

SPOKANE COUNTY.

Silver Hill.—Wolframite and scheelite are found in quartz in close connection with a tin-bearing pegmatite at Silver Hill, 10 or 12 miles southeast of Spokane. There has been no commercial production of tungsten ore from this deposit.

STEVENS COUNTY.

Bissell.—See Daisy.

Daisy.—Wolframite, with small quantities of gold, silver, pyrite, tourmaline, and molybdenite, occurs at a point 10 miles south of Daisy, 5 miles east of Columbia River, and 15 miles north of the Cedar Canyon deposits. No production has yet been made.

Deer Park.—Hübnerite is mined at Deer Park from quartz veins which are in part pegmatitic, carrying white mica and feldspar, and which cut metamorphosed clay shales. Some ore has been shipped.

Springdale district, Cedar Canyon.—Quartz veins carrying wolframite, a little scheelite, and a small quantity of bismuth cut granitic and metamorphic rocks at Cedar Canyon, about 15 miles west and a little south of Loon Lake and 6 or 7 miles east of Columbia River. They were formerly known as the Deer Trail deposits. They are actively mined.

WHATCOM COUNTY.

In the northeast corner of Whatcom County wolframite occurs in quartz veins. The deposit is near the Canadian boundary and about 35 miles from Loomis. An unsuccessful attempt at exploitation was made in 1907.

WYOMING.

Wolframite has been reported from several localities, but no specimens have been obtained and no details are at hand.

[1] Report on the geology and mineral resources of the central mineral region of Texas: Second Ann. Rept. Geol. Survey of Texas, 1890. Austin, 1891, pp. 597–600.

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NICKEL AND COBALT.

By FRANK L. HESS.

NICKEL.

PRODUCTION.

No nickel ore as such was mined in the United States during 1910, so far as is known to the United States Geological Survey. The only production made was from nickel which collected in the electrolyte of electrolytic copper refineries. Considerable quantities of nickel sulphate and nickel ammonium sulphate are made from this source. One company which, in 1909, made the salts mentioned, smelted the crude material to metal in 1910. Another company which made and marketed nickel salts in 1909 sold their crude salts in 1910 to the Orford Copper Co. for refining. The latter company produces a large tonnage of both nickel sulphate and nickel ammonium sulphate each year.

The figures of production can not be given, as not more than two firms produced any one salt or the metal. Probably the larger part of the nickel from refinery electrolytes is of foreign origin.

The plant of the North American Lead Co., at Fredericktown, Mo., was not operated during the year. The company's affairs became so involved that its plant was sold at a forced sale.

The North Carolina Nickel Co.'s plant at Webster was also idle through the year.

The use of nickel is apparently growing, especially in steel and in the recently introduced alloy known as monel metal. This alloy is produced by smelting the nickel-copper ore mined at Sudbury, Ontario, with no attempt to separate the copper from the nickel. The smelting process is thus made much shorter and cheaper, and the alloy can be sold at a lower price than pure nickel.

For some purposes it is better than any known metal, as it corrodes less easily than brass or bronze, and in strength compares well with steel. It may be cast by adding proper deoxidizing agents. For valves to be used under high steam pressure, where bronze is said to soften and give way, monel metal does well. In propeller blades requiring great strength and resistance to corrosion, in roofing, in sulphuric-acid pumps, and in many other trying positions, it behaves excellently.

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IMPORTS.

The imports of nickel for consumption into the United States for the last five years, 1906 to 1910, inclusive, as reported by the Bureau of Statistics, have been as follows:

Imports of nickel for consumption into the United States, 1906–1910, in pounds.

	Nickel, nickel ore, and matte, nickel oxide, alloys of nickel with copper, etc.[a]		Value of manufactured articles of nickel.	Total value.
	Quantity.	Value.		
1906	34,082,042	$1,867,568	$8,963	$1,876,531
1907	18,598,638	2,233,867	9,159	2,243,026
1908	16,825,291	2,487,605	9,980	2,497,585
1909	22,194,102	3,034,407	1,866	3,036,273
1910	32,373,251	4,213,079	14,759	4,227,838

[a] Includes only the nickel content of ore and matte.

The imports for 1910 were divided as follows:

Imports of nickel for consumption into the United States in 1910, in pounds.

	Quantity.	Value.
Nickel, alloys, pigs, bars, etc	323,219	$128,005
Ore and matte (nickel content)	32,050,032	4,085,074
Sheets or strips and manufactured articles		14,759
Total	32,373,251	4,227,838

EXPORTS.

The United States refines much more nickel than it can use, so that although not an important producer it is a large exporter. Exports since 1901 have been as follows:

Exports of nickel, nickel oxide, and matte from the United States, 1901–1910, in pounds.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1901	5,869,655	$1,521,291	1906	10,620,410	$3,493,643
1902	3,228,607	924,579	1907	8,772,578	2,845,663
1903	2,414,499	703,550	1908	9,770,248	3,297,988
1904	7,519,206	2,130,933	1909	12,048,737	4,101,976
1905	9,550,918	2,894,700	1910	15,244,937	4,704,088

COBALT.

PRODUCTION.

No cobalt ores are known to have been produced in the United States in 1910. What appear to be the most promising deposits, those at Fredericktown, Mo., were not operated during the year. As stated under "Nickel," the smelter of the North American Lead Co., in which cobalt oxide had been made, was closed and sold.

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At Fredericktown cobalt occurs in linnaeite, which, when pure, is a sulphide of cobalt, but usually the cobalt is partly replaced by nickel, copper, or iron. The Fredericktown mineral probably carries all of these metals. Cobalt occurs with galena, chalcopyrite, and pyrite in lead mines; the copper, nickel, and cobalt minerals are saved as a by-product.

ALLOYS OF COBALT AND CHROMIUM.

During 1910 an important advance in the metallurgy and use of cobalt was announced by Mr. Elwood Haynes, of Kokomo, Ind. After much experimenting Mr. Haynes obtained a series of alloys of cobalt and chromium which, when compared with the metals and alloys in common use, show most remarkable qualities. He published an article upon cobalt-chromium alloys to which he has given the name "stellite," [1] which is in part as follows:

In 1905 I repeated some of the former experiments, with a view to utilizing the alloys of cobalt and nickel with chromium for ignition points, in connection with gas engines. I was soon able to produce both the alloys of nickel and cobalt in considerable quantity. I ascertained that the nickel-chromium alloy could be worked cold, while the cobalt-chromium alloy must be worked hot in order to obtain any degree of satisfaction.

The first pellets of the cobalt-chromium alloy, weighing from 15 to 30 grams, were obtained by heating mixtures of aluminum with the oxides of cobalt and chromium in crucibles lined with the oxide of aluminum. Some of these pellets were heated to redness and flattened out under the hammer, and while this could be done without cracking the alloy the metal was found to be very hard even at red heat.

I soon found that it was impracticable to reduce the alloy in this manner in large quantities. I accordingly purchased a considerable amount of pure cobalt and pure chromium and had a mixture of nearly equal parts of these metals fused in an electric furnace, the metals being placed in a carbon crucible lined with pure magnesia. The alloy was cast into a small bar, about one-fourth of an inch square, and 5 or 6 inches long. This alloy exhibited most of the characteristics of that obtained by reduction with aluminum, but it could not be drawn to any extent under the hammer without cracking. Whether this was due to the high percentage of chromium, or to slight impurities in the metals employed, I am as yet unable to say.

In order to determine what the effect of alloying the cobalt with smaller percentage of chromium would be, I again had recourse to the gas furnace and succeeded in melting a mixture containing 75 per cent cobalt and 25 per cent chromium in a crucible made of a very refractory material, which I compounded for the purpose. Much to my satisfaction, I succeeded in melting this alloy to a perfect fluid and poured it into an ingot mold, which gave me a bar of metal about one-half an inch square and 5 or 6 inches in length. This metal proved to be very sonorous and elastic, and if some care were used it could be hammered out into a rough strip.

After a considerable amount of experimenting with various purifying agents I finally succeeded in producing a very tough and malleable alloy, which could be hammered out into the thinnest sheet at a bright red heat without showing any sign of cracking. A razor blade was made from a bar of this alloy, and while it did not prove equal to the best steel for this purpose, it has been used hundreds of times for shaving, and after a year and a half shows practically no signs of wear, though, of course, it has been necessary to strop it frequently in order to keep it in good condition. The bar was made about two years ago, and I am sure that I have since produced metal that would be much more satisfactory for the purpose.

A test of tensile strength and elastic limit of this material was made, with results as follows: Elastic limit, 79,000 pounds; tensile strength, 96,000 pounds; elongation, 3 per cent. It will be seen from the above that both the elastic limit and the tensile strength of this material are superior to those of untreated steel, resembling more nearly those of good nickel steel. The elongation is quite low, but this is to be expected on account of the great hardness of the alloy, which is equal to that of mild-tempered tool steel. A test was also made of the modulus of elasticity of this material, which was found to be about equal to that of steel. This is a very significant fact, since heretofore it has not been possible, so far as I am aware, to form an alloy of

[1] Jour. Indus. and Eng. Chem., October, 1910, pp. 397-401. See also Stellite, a new alloy: Sci. Am. Suppl., vol. 70, Nov. 19, 1910, pp. 325-326, 3 figs.

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nonferrous metals which would show a modulus of elasticity comparable to that of iron and steel. And it is lack of this valuable property in various nonferrous mixtures which renders them inferior to iron for many important purposes.

A pocketknife blade and several table-knife blades were made from this material, and were found to be very satisfactory in every respect. One of these table-knife blades has now been in use for more than two years in the kitchen, where it was used for all sorts of purposes, such as cutting bread, turning griddle cakes, peeling and paring vegetables, and for various other purposes such as are known only to the culinary art. After all this use and abuse, the knife shows not the slightest trace of tarnish, and has held its luster so well that when exposed to the sun it shows a reflection which dazzles the eyes.

By mixing the alloy with small quantities of other substances, its properties may be modified to a remarkable degree. By this means I have obtained alloys, or combinations, which, while very brittle, would readily scratch quartz crystal.

By reducing the quantity of chromium to some extent, and adding certain other materials, alloys which are practically proof against nitric acid can readily be obtained, which are sufficiently soft and malleable to be worked cold, having a hardness not much greater than that of mild, untempered steel.

Between these two extremes a great variety of combinations can be made which are suitable for use for various purposes. For example, I have produced an alloy of sufficient hardness that when it is formed into a small bar, say one-half inch wide, one-fourth inch thick, and 3 inches long, and one of the ends shaped for a cold chisel, a 20-penny nail can be cut in two without marring the edge of the chisel in the slightest degree. I have formed another alloy into a small lathe tool, about one-fourth inch square and 3 inches long, which showed cutting qualities comparable to high-speed tool steel. In fact, in some respects, especially under high speed and light cuts, it has stood the test for a long time, where high-speed steel failed almost instantly, on account of the intense heat generated. I wish it distinctly understood, however, that I do not recommend this material as yet for lathe tools, though it would have a high value for this purpose if it were not obliged to compete with alloy steels.

An alloy of 75 per cent cobalt and 25 per cent chromium, to which small quantities of other metals are added, is not only sufficiently hard for good edge tools, but is quite tough, and can be bent much beyond its elastic limit without cracking, resembling in this respect the alloy steels, but, generally speaking, it is much harder. A bar of the alloy, one-fourth inch square, can be bent at right angles without showing any signs of cracking.

Chemical properties.—When the mixture of cobalt and chromium is heated to whiteness in a crucible, the cobalt first commences to fuse and immediately begins to combine with the chromium, and if the metals are mixed in the proportion of about three parts, by weight, of cobalt to one of chromium, a eutectic is formed which seems to possess a lower melting point than either cobalt or chromium.

The color of the alloy lies between that of steel and silver, and is especially pleasing in bright light. The alloy is also readily polished, but requires special treatment in order to develop its highest luster.

The most remarkable property of this combination, however, is its resistance to corrosion. It is equaled in this respect only by gold and the metals of the platinum group. It is attacked slowly by dilute hydrochloric acid and somewhat vigorously by the strong acid, especially when heated. Momentary exposure, however, to either dilute or strong hydrochloic acid has practically no effect on the metal. Both strong and dilute sulphuric acid attack it very slowly when cold, and not very rapidly even when heated. Nitric acid is totally without action upon it, and a polished piece of the alloy may be boiled in that substance for hours without affecting the luster of the metal in the slightest degree.

Solutions of the caustic alkalies are also totally without action upon it, even when boiled for hours. The alloy is likewise proof against all atmospheric influences, whether the air be moist or dry, and retains its brilliant luster for months, or even years, under severest conditions. Even sulphuretted hydrogen, when present in the atmosphere in large quantity, is totally without action upon it.

Its resistance to culinary operations has already been mentioned.

When the metal is heated in contact with the atmosphere it retains its color up to a temperature approaching a dull red, or about 500° C., when it shows a faint straw color, which deepens as the temperature rises, passing through bronze-yellow, purple, blue, and finally terminating in blue-black.

The alloy shows no scale, even when heated to bright orange, and the film of oxides does not seem to increase in thickness after prolonged heating.

It can readily be melted in an open crucible in a gas furnace with practically no oxidation, so long as a slightly reducing flame is maintained. This is all the more

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remarkable on account of its high melting point, which seems to be about 1,650° C. for the 25 per cent alloy. Indeed, the metal has been melted in this manner with a loss of less than one-half of 1 per cent.

Uses.—The uses for any substance may be limited in several particulars: First, by the limitations of its fitness; second, by the possibility of producing it in proper form; and, third, by its cost. This material is particularly suitable for all kinds of small cutting instruments, since it takes an edge comparable to that of tempered steel. It is especially adaptable to the manufacture of pocketknives, on account of the beauty of its color and the brilliancy of its luster, both of which remain permanent under all circumstances, thus giving the blades a particularly attractive appearance. Knives of this description may be used for cutting fruit without danger of marring their luster in the slightest degree.

Alloys in certain proportions will also doubtless find a wide use for surgical instruments, since they resist perfectly all sterilizing solutions.

The alloy is perhaps better adapted for table cutlery than anything that has ever yet been produced. We all know too well that a silver-plated knife, for example, is ill adapted for cutting meat, and it can not be sharpened without destroying the plating. Steel knives, on the other hand, while they cut well, require endless labor to keep them in presentable condition, and at best, they are unsightly in appearance.

The alloy is also of considerable interest to the chemist and physicist. It is admirably adapted for the manufacture of fine weights for balances, scrapers, spatulas, and other laboratory appliances. * * *

The alloy is also particularly well adapted for the manufacture of standard weights and measures, such as the gram, kilogram, meter, etc., and it is difficult to see in what respect it is inferior for this purpose to the expensive platinum-iridium alloy now in use.

The alloy could readily be made into laboratory vessels, cooking utensils, spoons, forks, etc., and it is limited in this respect only by its cost.

Cost.—Regarding the cost of production and manufacture, I am not at present prepared to make definite statements. I have succeeded, however, not only in obtaining the raw material at lower prices, but have also reduced the cost of production to a considerable degree, so that it is now possible to produce the alloys with as much dispatch and precision as is possible in the production of common alloys.

For eight months the present writer has had a small carving knife made by Mr. Haynes from stellite, and although frequently used the knife apparently has the same excellent luster as when received. It has retained a keen edge far better than any steel knife which he has tried and has a much handsomer appearance.

Mr. Haynes's discovery furnishes the first use that has been known for metallic cobalt, and it seems as if there should be such a demand for the alloy that the cobalt market would be considerably widened.

At various smelters many tons of cobalt are lying in speiss made in the reduction of silver ores from Cobalt, Ontario. The cobalt is at present useless, and the companies owning it would be glad to find a market for the metal. The output from the mines could easily be increased on demand.

IMPORTS.

The imports for consumption of cobalt into the United States since 1901 have been as follows:

Cobalt oxide, ore, and zaffer imported into the United States for consumption, 1901–1910, in pounds.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1901	71,969	$134,208	1906	41,084	$83,167
1902	79,984	151,115	1907	48,013	74,849
1903	73,350	145,264	1908	219,008	17,077
1904	42,354	86,925	1909	12,132	11,096
1905	70,048	139,377	1910	14,985	6,352

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VANADIUM, TITANIUM, MOLYBDENUM, URANIUM, AND TANTALUM.

By Frank L. Hess.

VANADIUM.

CONDITION OF INDUSTRY.

The interest in and the use of vanadium undoubtedly increased during 1910; several thousand tons of low-grade ore were produced; and there was considerable inquiry by companies using or reducing the metal for vanadium claims from which commercial production could be made.

Arizona.—The occurrence of vanadinite has been noted at many localities in Arizona, but from only one was a production reported in 1910. In the course of development work J. J. Sullivan mined from claims near Kelvin several hundred tons of ore carrying vanadinite. None was marketed.

Colorado.—In Colorado, at Newmire, the Primos Chemical Co. operated the plant which they took over from the Vanadium Alloys Co. in 1909. Headquarters and other buildings were erected and improvements were made in the mill.

The ore used by the company is produced from their mines on Big Bear Creek, about 2½ miles south of Newmire. The mines are conveniently located on both sides of and a few feet above the creek with a down-grade haul from the mines to the plant. The Rio Grande Southern Railroad runs by the plant. The ore used is sandstone impregnated with roscoelite or a mineral much like it, and is singularly free from uranium. The deposits are persistent, thick, and easily worked. The accompanying minerals are few, consisting of a little pyrite, some carbonaceous matter, and carnotite stains along some of the joint planes.

The vanadium in the ore is obtained in the form of ferric vanadate at Newmire and is shipped to the company's works at Primos, Pa., for reduction to ferrovanadium.

The General Vanadium Co., an English organization with a branch office in Baltimore, Md., worked the Jodandy and other claims in the Paradox Valley, 50 miles west of Placerville, Colo. The ore contains carnotite and some black and some red vanadium minerals, the composition of neither of which is well understood. The red mineral occurs in small quantities and may be, at least in part, a calcium vanadate. The company also bought ores, which were shipped with those of its own production to Liverpool, England, for treatment. The uranium is separated from the ore and the vanadium-bearing

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residue is smelted to ferrovanadium. Ores must carry 3 per cent metallic vanadium to pay for shipping.

The Standard Chemical Co. obtained claims in Paradox Valley and vicinity during the year, but shipped no ore. The property contains carnotite, a complex, variable uranium and vanadium mineral.

The United Vanadium Co., of Springfield, Ohio, bought part of the claims of W. H. Keirnes and partners on Leopard Creek, about 2 miles north of Placerville, and has done some prospecting. Other claims are held under bond and lease.

Several lessees and operators each produced a few tons of ore in Paradox Valley and neighboring territory, on Fall Creek, and along San Miguel River. This ore was mostly sold to the General Vanadium Co. Considerable prospecting was done along Leopard Creek for a distance of 5 or 6 miles above its mouth.

Some roscoelite occurs in the gold mines of Boulder County, Colo., but none has been produced commercially.

New Mexico.—In the Caballos Mountains, 15 miles west of Cutter, N. Mex., operations were begun by the Vanadium Mines Co., of Pittsburgh, upon the White Swan and Dewey claims, which contain deposits of vanadinite, with which are associated descloizite, wulfenite (lead molybdate), fluorspar, copper minerals, galena, and barite. Some mining was done and much money was spent on an oxide plant at Cutter on the Atchison, Topeka & Santa Fe railway, on a concentrating plant 2 miles south of the mine and a pumping plant and wells 3 to 5 miles east of the mine, and on a pipe line to carry the water to the concentrating plant and mine.

A small quantity of vanadium pentoxide is reported to have been made near the close of the year.

Ralph Widener has claims on a vein about a mile south of the Vanadium Mines Co.'s property; he did considerable prospecting and took out some vanadinite. J. H. Hardin has sunk a shallow shaft on the Lucky Bill claim adjoining the Widener property on the northeast. The shaft is on the vein worked by Mr. Widener, and vanadinite is found here also. In all of the claims a greenish mineral high in vanadium occurs in small quantity. It is thought to be a descloizite.

Near Bayard some prospecting was done for vanadinite, with a degree of success.

At Hillsboro the Vanadium Queen Mining Co. has property which is said to carry vanadium through a length of 3 miles. The vanadium is said to occur in the form of vanadinite at one end of the property and as descloizite at the other end. No production is known to have been made during 1910.

Reduction.—The principal difficulty found in the reduction of vanadium ores seems to be the separation of other rare metals. Most of the Colorado ores are carnotite and carry uranium. Most of the vanadinites are associated with wulfenite and many of the vanadinites are said to carry a little tungsten also, probably as stolzite, the lead tungstate. Uranium and molybdenum are difficult to separate commercially from vanadium and their presence in ferrovanadium is objectionable, as steel making is each year carried on with more exactness and care for details, so that when a ferro is used nothing but pure material is wanted, although the other metals present may be desirable by themselves and under other circumstances.

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Most of the vanadium ore produced in this country was used here. Besides the ores of domestic production, however, a considerable quantity of vanadium ore was imported by the American Vanadium Co., of Pittsburgh, Pa., from their mines at Minasragra, Peru. The ore is patronite, a carbonaceous material carrying much sulphide of vanadium, some nickel and titanium, and a little molybdenum.[1] According to the analyses given in Dr. Hillebrand's article, the vanadium content runs from 15.36 to 19.53 per cent. The figures of imports of ore are not available, but during 1909 there was exported from Peru, presumably to this country, 1,928 short tons[2] said to contain 482 short tons of vanadium, and valued at $243,140. The figures showing contained vanadium should probably be taken to mean vanadium pentoxide. As given they show a content of 25 per cent, but if taken to mean V_2O_5 they show a content of 17 per cent metallic vanadium which is close to the average given by the analyses quoted.

Use.—The use of vanadium has been mostly in steel, to which it is said to impart great toughness and resistance to shock. Figures published by the American Iron and Steel Association show that 9,049 long tons of steel were treated with vanadium during 1910. Smaller qauntities are used in cast iron and bronze, and an effort has been made to increase its use as a therapeutic agent.

Concerning the output of steel treated with vanadium, George E. Lees writes in the Engineering and Mining Journal, September 30, 1911, as follows:

> In the Journal of August 26, page 400, the production of alloy steels in the United States for the year 1910 was given, according to the report of the American Iron and Steel Association. The total for vanadium steel is stated as 9,049 tons, which I am confident, is incorrect, as I have written to the principal manufacturers of vanadium steel and have their replies, showing that the aggregate production of vanadium steel in the United States for 1910 was approximately 40,000 tons.
>
> I have exact statements from 21 manufacturers; several refused to disclose their figures. This total of 40,000 tons includes only vanadium steel and not the large amount of vanadium used in the manufacture of iron castings and a smaller quantity used in brass, bronze, white metal, and bearing metals.
>
> In Engineering for May, 1911, a contributor estimates that the annual consumption of metallic vanadium in the United States is 250,000 pounds, and that it is used at the rate of 5 pounds per ton of steel. On this basis the production of finished vanadium steel would have been 50,000 tons, which is certainly a closer statement of facts than the 9,049 tons as given in the article that was published in the Journal. It must also be taken into consideration that the alloy steel that showed the highest total in that article represented nothing but rails, while the total given herein for vanadium steel represents a much higher class of product and includes automobile and locomotive forgings, gears, locomotive axles, piston rods, tool steel, and other manufactured parts for high-duty service.

Prices.—The prices paid for vanadium ore seem to have been largely a matter of personal bargaining and, as with other ores, more or less dependent upon their vanadium content.

One offer for ore was $5 per unit[3] of vanadium pentoxide (V_2O_5) and $10 per unit of uranium oxide (U_3O_8) contained in the ore, but the combined oxides must equal or exceed 3½ per cent and the percentage of V_2O_5 must exceed that of U_3O_8.

From one mine ore carrying 3.75 per cent metallic vanadium and a considerable, though unknown, percentage of uranium was pur-

[1] Hillebrand, W. F., The vanadium sulphide, patronite, and its mineral associates from Minasragra, Peru: Jour. Am. Chem. Soc., vol. 29, No. 7, 1907, pp. 1023-1025.
[2] Figures furnished by the Pan-American Union, Oct. 18, 1911.
[3] The unit is 1 per cent of a short ton, or 20 pounds.

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chased at 67 cents per pound for the metallic vanadium contained. Eighty per cent of the purchase price was paid f. o. b. Placerville and 20 per cent after the ore reached England. Nothing was paid for the contained uranium.

Other prices were said to range from 39 cents to 55 cents per pound for the metallic vanadium contained, 80 per cent to be paid when the sacked ore was put aboard the cars at Placerville and the other 20 per cent upon the arrival of the ore at Liverpool.

The determination of vanadium is apparently not performed in the same manner by different chemists and has led to discordant results between sellers and buyers and to consequent disagreements as to amounts due for ore.

Production.—Figures showing the domestic production of vanadium ore may not be given, as all the ore produced was handled by two firms, and to give the figures would disclose the business of each.

TITANIUM.

Production.—The domestic production of titanium ore during 1910 consisted of rutile from Roseland, Nelson County, Va., and of highly titaniferous iron ore from the Adirondack Mountains, in New York.

In the former place the American Rutile Co. operated their 10-stamp mill during part of the year, producing from 8,000 tons of ore, 566 short tons of concentrates, carrying from 75 per cent to 98 per cent TiO_2. The output was valued at $44,480.[1]

The ore, a pegmatite, carrying some ilmenite, is quarried from a broad face lying along Tye River. The best grade of concentrates is made by treatment with a magnetic separator. The quantity of titaniferous iron ore mined for use in producing ferrotitanium is not known to the Survey.

The General Electric Co., which in 1909 operated the American Rutile Co.'s property and prospected on other property in Nelson County, Va., leased property 2 miles from St. Urbain, near Bay St. Paul, Quebec, where a red rutile is found scattered through ilmenite, with sapphirine, basic feldspars, and probably apatite. About 1,000 tons of this ore is said to have been sent to the company's Lynn works, and is reported to have carried about 6 per cent rutile.

Use.—The use of titanium as a ferroalloy grew during the year. Many railroads ordered experimental lots of titanium-treated rails, and 256,759 long tons of rails were rolled from steel to which ferrotitanium had been added. Much earnest experimenting is being done by railroads and rolling-mill operators to make a rail which will give more satisfactory service than those now in use. According to statistics given by James M. Swank in the Annual Statistical Report of the American Iron and Steel Association for 1910 (p. 74), there were rolled in 1910 256,759 long tons of titanium-treated steel rails and 4,775 long tons of steel rails treated with manganese, nickel, etc. The entire rail output of the United States during 1910 was 3,636,031 long tons.

The total production of steel treated with other metals is given by Mr. Swank (p. 74) as follows:

[1] These figures are published through the courtesy of Mr. W. M. Slater, president of the American Rutile Co., Washington, D. C.

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Production of steel treated with other metals in 1910, by metals.

	Long tons.
Titanium	326,316
Nickel	106,707
Nickel chromium	52,021
Chromium	23,550
Manganese	19,360
Vanadium	9,049
Other alloys	30,816

Certain steel makers are now advertising titanium steel, claiming that although no titanium is left in the steel, the removal of gases and impurities effected by it greatly increases the good qualities of the steel.

According to figures obtained from the Bureau of Statistics titanium alloys valued at $767 were imported during 1910. A few tons of rutile were exported to England and Germany.

MOLYBDENUM.

No production of molybdenum ores is known to have been made in the United States in 1910, and no new uses are known to have been developed. A small quantity of molybdenum is used by some makers of tool steel and to supply that demand 9.04 short tons, undesignated except that it was either molybdenum or ferromolybdenum worth more than $200 per ton, was imported. The imports were valued at $14,402. It is probable that some ore also was imported, but the customs returns show nothing of it.

URANIUM.

Except as incidentally taken out with vanadium ores, no uranium ores are known to have been mined in the United States during 1910. The popular interest in uranium is almost wholly on account of its connection with radium, the properties of which appear so marvelous, when compared with more familiar materials. No radium extraction, except on a small scale, is known to have been attempted in the United States, though experiments looking toward larger operations have been under way.

The uses of uranium and its compounds are comparatively few and not extensive, the principal ones being for making yellow glass, for yellow glazes on pottery, and in a less degree as a chemical reagent. The attempt to use uranium in steel seems to have been given up, as it apparently imparts about the same properties as tungsten and is very much more expensive. During 1910, according to the Bureau of Statistics, oxide and salts of uranium to the value of $10,176 were imported; the quantity is not given.

TANTALUM.

There was practically no demand for tantalum ore in the United States during 1910, and only a few hundred pounds of columbite were mined. One small lot was taken out by Emil Hesnard, of Keystone, S. Dak., in the Black Hills, and another small lot was mined by E. E. Smith, of Canon City, Colo. Neither sold any tantalum ore during the year.

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So far as known the only firm reducing tantalum from its ores is Siemens & Halske, A.-G., of Charlottenburg, Germany. They draw tantalum wire, which is sold to incandescent electric-lamp manufacturers, and sell metal to firms which manufacture surgical and dentists' instruments and pens. Small burnishers for dentists' use, costing $3 or $3.50, are regularly carried by dentists' supply houses in this country.

Tantalum pens are expensive, costing in Germany 3 to 5 marks (72 cents to $1.19) each. The writer has been using one for a short time, but not sufficiently long to form an idea of the pen's lasting qualities. The pen is elastic and writes smoothly.

During 1910 the firms forming the National Electric Lamp Association used 1,500,000 meters, equivalent to 4,921,250 feet, or more than 932 miles, of tantalum wire for filaments in incandescent lamps. The wire was of various sizes, and was valued at $43,000. The weight is not known, but was probably less than 100 pounds.

It seems likely that the tantalum used for lamps in the rest of the world is not greatly larger in quantity than that used in this country. The quantity used in instruments and pens is not large, and probably the whole output of metallic tantalum does not exceed a short ton per year. It is made from Australian and American ores. Tantalum minerals very free from columbium and other objectionable elements are found in considerable quantity in the Greenbushes and Pilbara districts of Western Australia, but the American tantalum minerals are mostly columbites carrying large percentages of columbium, so that at the same price Australian tantalum minerals are preferable. The latter are stibiotantalite (tantalate of antimony), tantalite (iron tantalate), and manganotantalite (tantalate of manganese).

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TIN.

By FRANK L. HESS.

PRODUCTION.

Activity was shown in four of the tin-bearing districts of the United States in 1910, but the output was an insignificant part of the world's production. From about 2,000 tons of crude ore about 59 short tons of concentrates were obtained, valued at $23,447.

Alaska.—In a short season's work, under adverse weather conditions, the American Tin Co. sluiced a little over 15 short tons of stream tin, carrying 66.05 per cent metallic tin, from the gravels of Buck Creek, Alaska. The concentrates were shipped to Penzance, England, and sold at 42.1 cents per pound of contained tin. The stream tin from Buck Creek carries some gold, but nothing was received for it. Prospecting in the tundra on the south side of Buck Creek showed a higher tin content in the underlying gravels than had been known to exist. The percentage of tin carried was so high and the extent of the gravels was so large that plans were laid for putting a dredge on the creek in 1911.

On Cape Mountain the Bartels Tin Mining Co. did some work and made preparations to patent its claims. The United States-Alaska Tin Mining Co. also did some work on its property but made no production.

On Lost River assessment work was done, with no production.

On Sullivan and Cache creeks, near Hot Springs, a short distance above the mouth of Tanana River, stream tin occurs in the gold placers in considerable quantity, but none has been saved. Most of the tin is found on Sullivan Creek. Cache Creek is a tributary of Sullivan Creek and is tin bearing only on the lower part.

North Carolina.—At Lincolnton the Piedmont Tin Mining Co. carried on development work and operated a mill for a short time. A small quantity of concentrates is said to have been sold in England. The tin occurs in cassiterite as an original mineral in pegmatite dikes.

South Dakota.—At Hill City, in the southern Black Hills, further prospecting was done by the Pahasa Mining Co., which took over the properties of the defunct Harney Peak Tin Mining & Manufacturing Co.

At Tinton, in the northern Black Hills, the Tinton Reduction Co. made numerous changes in its mill and produced 38 tons of concentrates, from which 19 tons of tin were smelted and shipped to England The occurrence of the tin is very similar to that in North Carolina—original cassiterite in pegmatite.

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Texas.—In the Franklin Mountains, 12 miles north of El Paso, development work was prosecuted by the El Paso Tin Mining & Smelting Co. on 6 veins, most of which are short. A mill and small smelter fired with oil were built under the direction of Mr. Regis Chauvenet and 6,387 pounds of metallic tin, valued at $2,586.79, were produced in 1910. The tin produced ran 99.80 per cent pure and is said to have sold for 3 cents per pound above the market price. The tin occurs in quartz veins following dikes of pink, highly feldspathic granite up to 2 feet thick. It also occurs in the dikes and in the biotite granite which the dikes cut. In the granite the cassiterite replaces feldspar and fills cracks. The granite is in some places silicified. A little wolframite and tourmaline accompany the cassiterite.

Although small, the tin deposits of the United States are so free from objectionable minerals, such as arsenides and pyrites, that what concentrates are produced sell for a high price.

SECONDARY TIN.

The figures collected by J. P. Dunlop, of the United States Geological Survey, show that the recovery of secondary tin as tin in 1910 was 7,217 short tons and that 6,686 short tons were recovered in alloys, making a total recovery of 13,903 short tons, valued at $9,481,800. In 1909 the figures as collected were: Metallic tin, 2,423 short tons; in alloys, 3,092 short tons; total, 5,515 short tons, valued at $3,281,425. Concerning these figures, Mr. Dunlop says:

> The production of tin from ore mined in the United States is almost negligible, so that the secondary recoveries constitute nearly the whole domestic supply. The figures for 1910 recoveries show a large increase over those for 1909, mainly because the quantity of metal recovered from scruff and drosses from tin and terne plate manufacturers was ascertained. Several plants made tin oxide and tin chloride from clean scrap tin, and the production of these compounds is calculated as metal to avoid disclosing the output of products having a limited use. Although a large quantity of tin is recovered from scrap by electrolytic treatment, and a smaller quantity is converted directly into oxide and chloride, the principal recovery is made from scruff and drosses, or in alloys.
>
> The use of old tin cans as a source of tin was not extended. The cost of collection, transportation charges, and inability to dispose of the black plate from which the tin is wholly or partly removed are the principal reasons given why more old tin cans are not utilized.

The recovered tin amounted in both quantity and value to more than 25 per cent of the imports of tin, and if this recovery had not been made the imports must have been by that much larger, which would have very seriously raised the price of tin. There is yet room for much improved metallurgical processes which will allow the saving of a larger proportion of the great and incessant waste in used tin cans.

IMPORTS.

According to figures furnished by the Bureau of Statistics, the United States imported for consumption during the year 1910, 52,528 short tons of tin, valued at $33,913,255; cassiterite, 42 tons, valued at $9,401; tin foil valued at $575; and tin of other forms valued at $2,905; a total value of $33,926,136. These are the largest imports of tin ever made into the United States. The value, however, was exceeded in 1906, when imports of 50,477 tons were valued at $37,447,315.

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The imports of tin for consumption into the United States since 1901 have been as follows:

Tin imported and entered for consumption in the United States, 1901–1910, in short tons.[a]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1901	37,280	$19,024,761	1906	50,477	$37,447,315
1902	42,522	21,263,337	1907	41,257	32,074,263
1903	41,567	22,265,336	1908	41,267	23,923,560
1904	41,472	22,356,895	1909	47,662	27,558,546
1905	44,188	26,316,023	1910	52,528	33,913,255

[a] These items do not include the tin contained in imported ore, tin foil, or other manufactures.

WORLD'S SUPPLY OF TIN.

The world's supply of tin as shown by shipments has for the last four years been approximately as follows:

Supply of tin in 1907 to 1910, inclusive, as shown by shipments, in short tons.

	1907	1908	1909	1910[a]
Total shipments:				
Straits Settlements	58,800	67,760	65,459	61,152
Australia	7,112	6,552	5,992	5,208
Bolivia	17,136	19,040	23,523	19,656
South Africa	.....	1,904	916	3,360
China, to Europe and United States	224	.....	.....	2,464
Banka sales in Holland	12,197	12,880	12,992	15,120
Billiton sales in Java	2,408	2,465	2,465	2,464
Production in Cornwall	5,488	6,048	5,802	6,496
Total	103,365	116,649	117,149	115,920

[a] Compiled by C. Mayer, sec., Annual Statistical Review, New York Metal Exchange, New York, 1911, p. 13.

To the world's supply should be added the quantity of secondary tin recovered during the year. The European figures are not available, but are probably equal to those of the United States and possibly exceed them. If the world's recovery be taken in round numbers as 27,000 tons, the total supply for 1911 was about 143,000 short tons.

PRICES.

Prices as published by the American Metal Market and Daily Iron and Steel Report in its "Metal statistics, 1911" (p. 149), show a gradual rise from 32.74 cents per pound in January to 38.28 cents per pound in December, though the rise was more rapid toward the close of the year than in the first part. The average price was 34.27 cents per pound. These prices, of course, apply only to transactions in large lots of metal.

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CHROMIC IRON ORE.

By Ernest F. Burchard.

INTRODUCTION.

Chromite is widely distributed through areas of serpentine and associated basic rocks in various parts of the United States. Serpentine areas are found at a few localities in the region of old metamorphic rocks east of the Appalachian region from New England to Georgia, at various points in the Rocky Mountains, throughout the extent of the Sierra Nevada and Coast Ranges in California, and at a few points in the Cascade Mountains. Chromite occurs disseminated widely through many of these areas, but its concentration is local. Chromite localities are known in Massachusetts, Pennsylvania, Maryland, North Carolina, Wyoming, and California.

Almost the entire production of chromic iron ore since 1880 has come from California, with minor quantities from Wyoming. In 1910 the production of chrome ore, amounting to 205 long tons, came from California. The greater part of the ore mined was used for furnace linings.

As in previous years, the importation far exceeded the domestic production. In 1910 the imports of chrome ore into the United States from New Caledonia, Greece, and other countries amounted to 38,579 long tons.

Chromite is the only commercially important ore of chromium. It is a mixture of chromic oxide (Cr_2O_3) and ferrous oxide (FeO) in various proportions, the former averaging between 40 and 60 per cent, though occasionally running as low as 10 per cent, the latter running from 10 to 50 per cent. The theoretical composition of chromite is $Cr_2O_3.FeO$ (Cr_2O_3 68 per cent; FeO 32 per cent). The price is based on 50 per cent ore.

Chrome ore is used extensively in the manufacture of ferrochromium, employed for making special steels, alone or in combination with tungsten, manganese, nickel, or other steel-hardening metals. It is also used for lining copper, lead, steel, and other furnaces where the corrosive action is very great. For this purpose it is used either in the crude form or as chrome brick. A third use of chromite is in the manufacture of various chromium compounds, such as oxides and metal chromates for use as pigments and as dyes, and alkaline bichromates for use as mordants and as tannages.

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A more complete discussion of the sources, uses, and occurrence of chromite was published in the report on chromic iron ore for 1908.[1]

CHROMIC IRON ORE INDUSTRY.

Production.—The quantity of chromic iron ore marketed in 1910 amounted to 205 long tons, valued at $2,729, as compared with 598 long tons, valued at $8,300 in 1909. The ore was mined in Siskiyou and Shasta counties, Cal., and was used for lining local furnaces. The stock of chromite at the mines at the close of 1910 amounted to about 402 long tons, according to reports received by the Survey. No domestic ore was reported as used in the manufacture of chrome alloys, potassium bichromate, chrome paints, dyes, or other chemical materials.

The following table gives the quantity and value of chrome ore produced in the United States since 1880. All the ore was obtained from California, except in 1908 and 1909, when part of the production came from Wyoming:

Production (sales) of chromite in the United States, 1880–1910, in long tons.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1880	2,288	$27,808	1896	786	$6,667
1881	2,000	30,000	1897	.....	.....
1882	2,500	50,000	1898	.....	.....
1883	3,000	60,000	1899	.....	.....
1884	2,000	35,000	1900	140	1,400
1885	2,700	40,000	1901	368	5,790
1886	2,000	30,000	1902	315	4,567
1887	3,000	40,000	1903	150	2,250
1888	1,500	20,000	1904	123	1,845
1889	2,000	30,000	1905	22	375
1890	3,599	53,985	1906	107	1,800
1891	1,372	20,560	1907	290	5,640
1892	1,500	25,000	1908	359	7,280
1893	1,450	21,750	1909	598	8,300
1894	3,680	58,231	1910	205	2,729
1895	1,740	16,795			

Prices.—The price of chrome ore varies from $10 to $20 per ton, according to grade of ore and conditions of supply. Imported ore from New Caledonia carrying 50 per cent chromic oxide was quoted in New York in 1910 at an average price of $15 per long ton in carload lots, exclusive of cost of transportation. In 1909 the price averaged $16.24 per ton. If the chromic oxide exceeds 50 per cent, the value of the ore rises in proportion; if the chromic oxide is less than 50 per cent the value of the ore decreases at a more rapid rate. The price of the California ore is governed almost entirely by local conditions, as there is little or no competition with foreign ores.

The price of chrome bricks f. o. b. Pittsburg is $175 per thousand. American potassium bichromate was sold at 7⅞ cents to 8 cents per pound and the Scotch product at 10¾ cents per pound in the latter part of 1910.

Imports.—During the last seven years important quantities of chromite have been imported from New Caledonia, Greece, Canada, Great Britain, Asiatic Turkey, and Japan, and minor quantities from

[1] Harder, E. C., Chromic iron ore: Mineral Resources U. S. for 1908, pt. 1, U. S. Geol. Survey, 1909, pp. 751–770.

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European Turkey, Belgium, Germany, France, Cuba, Australia, Tasmania, New Zealand, and Portuguese Africa. In 1910, Canada exported 15 short tons of chromite, valued at $150, according to the official preliminary reports, as compared with 1,794 short tons, valued at $20,858, in 1909.

The total imports of chrome ore in 1910 amounted to 38,579 long tons, valued at $415,768, as compared with 39,624 long tons, valued at $460,758, in 1909.

The following table shows the imports for consumption of chrome ore and of various manufactured chromium products into the United States from 1906 to 1910, inclusive:

Chromate and bichromate of potash, chromic acid, and chrome ore imported and entered for consumption in the United States, 1906 to 1910, inclusive.

Years.	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
1906	80,098	$2,124	1,307	$331	43,441	$557,594	$560,049
1907	18,171	1,307	1,834	403	41,989	491,925	493,635
1908	216,081	15,453	3,805	708	27,876	345,960	362,121
1909	537,017	28,837	7,559	1,412	39,624	460,758	491,007
1910	406,790	19,569	9,850	1,635	38,579	415,768	436,972

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PLATINUM AND ALLIED METALS.

By WALDEMAR LINDGREN.

PLATINUM.

DOMESTIC PRODUCTION.

CRUDE PLATINUM.

The conditions of platinum production in the United States, where the metal is obtained mainly as a by-product in placer-gold mining, did not change materially during 1910. The output, though varying considerably, has been on the whole larger since 1900 than in the preceding decade. The production of crude platinum in 1910 was 390 troy ounces, a decrease of 282 ounces compared with the output of 1909; the reported value in 1910 was $9,507, or $3,296 less than in 1909. The average price paid was $24.38 per ounce, compared with $19 in 1909. Crude platinum generally contains iridium, iridosmine, and gold, besides some remaining black sand. The platinum content of the crude sand varies considerably, the average being probably about 70 per cent.

The entire output of crude platinum in the United States is recovered from placer mines in Oregon and California, which also produce gold. The production of California in 1910 amounted to 337 troy ounces of crude platinum, valued at $8,386. Of this, 304 ounces were recovered as a by-product in dredging operations in Butte, Yuba, and Sacramento counties; smaller quantities were recovered from river gravels in Siskiyou and Trinity counties, and a few ounces from workings in beach sands in Humboldt County.

In Oregon the principal production reported comes from beach sands near Port Orford, in Curry County, and near Bullards, in Coos County. The quantity recovered in 1910 was only 53 troy ounces, valued at $1,121.

No production was reported from the Rambler mine,[1] in Wyoming, nor from the deposit recently discovered in southern Nevada east of Moapa, where a dike of peridotite in schist contains copper minerals and carries a little platinum,[2] as described in Mineral Rources for 1908 and in a recent bulletin of the Survey.

[1] Platinum in Wyoming: Eng. and Min. Jour., Mar. 4, 1911, p. 460. Concentration of platiniferous copper ore at the Rambler mine, Wyo.: Metall. and Chem. Eng., February, 1911, pp. 75–78.
[2] Bancroft, Howland, Platinum in southeastern Nevada: Bull. U. S. Geol. Survey No. 430, 1910, pp. 192–199.

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REFINED PLATINUM.

PRODUCTION FROM DOMESTIC SOURCES.

The production of refined platinum from crude metal derived from placers is calculated on the basis of a content of fine metal of 70 per cent, and, thus computed, 273 fine ounces is found to have been the domestic output from placers in 1910.

The United States Mint obtains annually from its refinery operations a considerable quantity of platinum, the largest part of which is derived from scrap platinum and from sweepings, etc., bought from jewelers and dentists. A small percentage of primary metal is, however, obtained in refining gold bullion received at the mint from placer and lode mines.

During 1910 private refineries also began the separation of the platinum metals from gold bullion. It is impossible to state accurately what part of this output is derived from domestic sources.

The best estimate that can be made would probably be about 500 fine ounces. Adding the refined equivalent of the domestic crude platinum to this, we obtain 773 ounces as the probable output of refined platinum from domestic ores in 1910.

Estimate of production of refined platinum from domestic ores in 1901–1910, in troy ounces.

Year.	Quantity.	Value.
1901	1,408	$27,526
1902	94	1,874
1903	110	2,080
1904	200	4,160
1905	318	5,320
1906	1,439	45,139
1907	357	10,589
1908	750	14,250
1909	638	15,950
1910	773	25,277

PRODUCTION FROM FOREIGN SOURCES.

A considerably larger quantity of refined platinum is produced from imported crude platinum and from imported matte and bullion. This quantity is estimated at 4,800 ounces, valued at $156,960. The largest part of this is derived from crude platinum sand imported from Colombia and Russia, but some is also traceable to Canadian copper-nickel matte from Sudbury and various other sources.

TOTAL REFINED PLATINUM.

The total output of refined platinum in the United States from ores of domestic and foreign origin is then about 5,573 fine ounces, valued at $182,237.

SECONDARY PLATINUM.

Because of the strong demand for platinum which has s during recent years much secondary platinum is recovere United States from scraps of chemical apparatus, jewelr work, and incandescent-light fixtures. Owing to the peculi tions which exist in the platinum trade, complete statistic

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recovery can not be obtained from all refiners, but it is safe to say that the quantity thus recovered makes up a large percentage of the total imports. The principal domestic refiners of crude and secondary platinum are as follows: The United States Mint; Baker & Co. (Inc.), Newark, N. J.; Croselmire & Ackor, Newark, N. J.; S. S. White Dental Manufacturing Co., Philadelphia, Pa.; J. Bishop & Co., Malvern, Pa.; American Platinum Works, Newark, N. J.; Roessler & Hasslacher Chemical Co., Perth Amboy, N. J.

IMPORTS.

The imports of platinum from other countries, chiefly Russia, in 1910, did not differ much from those of 1909, but had a considerably higher value. The imports are shown in the following table:

Platinum metals imported and entered for consumption in the United States, 1902–1910.

Year.	Platinum ore or crude platinum, including unmanufactured products, ingots, bars, sheets, and wire.		Manufactured products, including vases, retorts, etc.	Total.
	Quantity.	Value.	Value.	Value.
	Troy ounces.			
1902	88,140	$1,950,362	$37,618	$1,987,980
1903	92,808	1,920,044	135,889	2,055,933
1904				1,879,155
1905	93,912	1,985,107	188,156	2,173,263
1906	137,928	3,601,120	187,639	3,788,759
1907	74,292	2,508,991	175,651	2,684,642
1908	50,844	1,095,754	134,119	1,229,873
1909	118,853	2,557,596	416,352	2,973,948
1910	118,280	3,320,699	333,965	3,654,664

PRICES.

There was a strong demand for platinum throughout the year, and in the closing months the highest prices ever reached for platinum were paid. For refined metal $29.50 per ounce was paid at the beginning of the year. In June the New York prices advanced to $32 per ounce, and during the remainder of the year there was an almost continuously rising market. In November prices reached the highest point, $39.75, but toward the close of the year a slight recession took place. At the close of the year quotations were $38.50 per ounce.

The strong demand continued in 1911, and in September of that year the asking price for refined platinum was $45 per ounce. For crude platinum St. Petersburg and Ekaterinburg are the principal markets. In 1910 at the former place prices opened at $22.79 in the beginning of the year, and in December the price paid was $32.34 per ounce.

Owing to the scarcity of iridium the prices for "hard metal," which is an alloy of that metal with platinum, have also advanced. Prices range from $2 to $5 higher than those for refined platinum. At the close of the year from $40 to $41 was asked for hard metal containing 10 per cent iridium. The highest prices paid were from $44 to $44.50, in November.

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The following table gives the prices of ingot platinum per troy ounce at New York, by months, for the calendar years 1908, 1909, and 1910:

Prices of ingot platinum per troy ounce on the New York market in 1908, 1909, and 1910, by months.

1908.			
January	$22.30	July	$19.60
February	22.10	August	18.20
March	21.80	September	18.60
April	21.75	October	21.15
May	21.35	November	24.50
June	19.85	December	24.10
1909.			
January	$24.25	July	$22.50
February	24.50	August	22.00
March	23.75	September	25.50
April	24.00	October	28.00
May	23.50	November	29.25
June	23.00	December	29.50
1910.			
January	$29.00	July	$33.00
February	28.75	August	33.00
March	29.13	September	33.63
April	29.25	October	37.50
May	29.55	November	39.44
June	31.38	December	38.75

The average price in 1910 was $32.70 per ounce.

USES.

During the last few years a large demand for platinum has developed in the jeweler's trade, especially for mounting precious stones, but also for chains and other articles. This demand accounts to a great extent for the phenomenal rise in the price of the metal when the scarcity of the supply and the failure to discover new sources of production are considered. Platinum is also in strong demand for manifold industrial and chemical purposes. These were described in some detail in the report for 1908.

FOREIGN PRODUCTION.

RUSSIA.

About 95 per cent of the production of platinum in the world is derived from five districts in the Ural Mountains, Russia. The platinum is contained minutely disseminated in a peridotite, from the erosion of which it has been concentrated together with the gold from quartz veins, in Quaternary gravels, which at present form the only available source of supply. The recent rise of prices for platinum has stimulated mining activity, but nevertheless production has increased but little. The fact seems to be that the resources of platinum-bearing gravels are limited and although now poorer deposits are worked, in part by dredging, the gravels are becoming exhausted. The Russian Government publishes statistics of the production of platinum, but it is generally admitted that these figures fall far short of the actual production, because much of the metal is smuggled across the border.[1]

[1] Hautpick, E. de, The Russian platinum industry in 1910: Min. Jour., London, Mar. 11, 1911.

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The official and the estimated actual production since 1900 are as follows:

Production of platinum in Russia, in fine ounces.

Years.	Official.	Estimated total.
1900	163,060	212,500
1901	203,067	315,200
1902	197,024	300,000
1903	192,976	226,000
1904	161,950	200,120
1905	167,950	200,450
1906	185,792	210,318
1907	172,752	310,000
1908	156,792	250,000
1909	164,118	264,000
1910	175,716	275,000

The production as given in the second column of this table is really only a crude estimate. Those best conversant with the situation state that the smuggled platinum amounts to about 50 or 60 per cent of the official figures.

The larger proportion of the Russian platinum is produced by washing the gravels by manual labor. About 20 per cent is recovered by dredging operations, many of the dredges obtaining both gold and platinum in their sluices. The average yield is stated to be 0.07 ounce per metric ton of gravel.

In Russia platinum is produced by five large operators: The Société Industrielle du Platine, The Platinum Co., Count Schouwaloff, Demidoff's Successors, and Prince Abemelik-Lazarieff. In 1900 these five operators produced 90.1 per cent of the total yield, but of late their aggregate output is said to have declined.

Almost all of the platinum produced in Russia is refined abroad, in London, by Johnson, Matthey & Co.; in Paris, by Quennesseu, de Belmont Legendre & Co.; and in Germany, by Heraeus & Co. (Hanau). The domestic refiners have already been mentioned.

In 1909 a French company, the Société Anonyme d'Industrie du Platine, obtained practical control for a term of years over the output of the principal operating companies. The small producers, who formerly had no organization and whose position was becoming intolerable, held a congress at Ekaterinburg to devise measures for their relief. The Russian Government assisted, but no definite results were reached. It was suggested that the export of crude platinum be prohibited, but whether so drastic a measure, involving the breaking of contracts of producers with refiners, will be adopted by the Russian Government is still doubtful.

COLOMBIA.

The platinum-bearing districts of Colombia were described in Mineral Resources for 1908. These placer deposits in which platinum and gold often occur together are at present under development, but their productive capacity is still imperfectly known. Next to the platinum deposits of Russia this region appears to be the most promising for future supply, but up to date the production has been small, amounting only to a few thousand ounces per annum. The production for 1910 was probably about 10,000 fine ounces, a great advance over the pro-

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duction of 1909, which was estimated at 6,000 ounces. Only a third part of the product was exported to the United States, the larger part being sent to an English refinery. It is reported that two small dredges were in operation in 1910, one on Patia River and another on Condoto River. A large part of the production is derived from washing by manual labor. There is no doubt that the production of platinum could be greatly increased, but there are many and serious difficulties in the way of successful mining. Lately it is reported that the Colombian Government has nullified all concessions on navigable rivers. The main shipping points are Buena Ventura and Tumaco.

CANADA.

The occurrence of platinum metals in copper and nickel ores at Sudbury, Ontario, has already been mentioned. Platinum-bearing gravels have been worked on Tulameen River, British Columbia,[1] and it is possible that a larger production may be expected from that source in the future.

A discovery of a platinum-bearing dike a few miles from Nelson, British Columbia, has recently been reported in the press, but details are not yet available.

NEW SOUTH WALES.

The small production from New South Wales is mainly derived from gravels at Fifield, near Parkes. A small quantity is also obtained from beach sands in some of the North Coast districts.

WORLD'S PRODUCTION.

The world's output of crude platinum in 1909 and 1910 is given approximately in the following table:

World's production of crude platinum in 1909 and 1910, by countries, in troy ounces.

Country.	1909	1910
Russia	a 264,000	a 275,000
Canada	a 30	a 30
New South Wales	440	332
Colombia	a 6,000	10,000
United States, domestic crude	672	390
United States, from foreign and domestic matte and bullion	b 600	b 1,000
Borneo and Sumatra	a 500	a 200
	272,242	286,952

a Estimated. b Refined.

IRIDIUM.

Properties.—Iridium is generally present in crude platinum in alloy with osmium as iridosmine, more rarely as native metal or in alloy with platinum. In its manufacture from crude platinum it is obtained as a sponge, which is then melted with the addition of a little phosphorus.[2] Melted iridium is a brilliant white, brittle

[1] Camsell, Charles, Platinum mining in the Tulameen district: Jour. Canadian Min. Inst., vol. 13, 1910 pp. 309-324.
[2] Moissan, H., Traité de chimie minérale, vol. 5, p. 896.

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metal intermediate in color between silver and tin. Its specific gravity is 22.421 (Deville and Debray), and its fusion point is very high—2150° to 2250° C. At 1100° C. iridium begins to oxidize to a purple oxide. Tungsten has a higher melting point than iridium, but oxidizes readily. Under ordinary conditions iridium is not attacked by any acid.

Uses.—Owing to its unique qualities iridium finds an extensive use. Most of the metal produced is probably used for the purpose of hardening platinum, the percentage of iridium in the alloys ranging from 5 to 20 per cent. Up to 10 per cent the alloys are ductile and malleable; those containing from 10 to 20 per cent of iridium are hard and difficult to work; where the alloy contains 30 per cent of iridium it is no longer attacked by aqua regia.[1] Iridium is further used for various scientific and technical purposes, such as standard weights, pivots, contact points, and fountain-pen points. For certain high-temperature experiments (above 1600° C.) iridium is rolled in sheets and welded into tubes. Pure iridium is difficult to work on account of its brittleness. Iridium black, an oxide of the metal, is highly valued as a pigment for decorating chinaware.

Production, import, and prices.—A few ounces of iridium are probably obtained from domestic crude platinum, but figures showing the quantity are not available. According to the Bureau of Statistics, 3,028 troy ounces of iridium and iridium in native combinations with platinum metals, valued at $140,232, or about $46.33 per troy ounce, were imported in 1910 into the United States. The price of iridium has been increasing rapidly. In 1909 the average price was about $35 per troy ounce; in 1910 the price rose still higher, and in October, 1910, iridium was quoted at $60 per ounce. The supply is evidently very limited.

OSMIUM.

Osmium is a hard and brittle bluish-gray metal, which, as stated above, generally occurs in combination with iridium. Its melting point is very high and its specific gravity is 22.48 (Joly and Vèzes). Thus far little use has been found for it, except for certain kinds of incandescent lamps. In 1910, according to the Bureau of Statistics, 939 ounces of osmium, valued at $32,647, or about $33.70 per ounce troy, were imported into the United States. As in the case of iridium there is little present probability of obtaining a supply of osmium from domestic sources.

PALLADIUM.

Palladium is a white metal intermediate in color between platinum and silver. It is malleable, has about the hardness of platinum, and has a low specific gravity—11.97 (Violle). It has a lower melting point than any other of the platinum metals—about 1,549° C.

Palladium finds a fairly large use in technology. Circles of astronomical instruments are made of it, and it is also employed in watchmaking. Its most extensive use is probably for certain alloys in dental work. It is also employed for soldering platinum metals. The demand for this metal is considerably greater than the supply.

[1] Moissan, H., op. cit., p. 899.

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The metal occurs in crude platinum, but rarely in considerable amount. It is also found in small quantities in certain copper deposits containing pyrrhotite and chalcopyrite, generally associated with a little gold, silver, and platinum. Alloys of palladium and gold (alloys known as white gold) also occur in nature. In gold and copper palladium appears to be present in larger quantities than platinum, and the metal is now recovered in several refineries. A certain part of this product is derived from secondary sources, such as jewelers' and dentists' scrap, but the larger part undoubtedly comes from the smelting of palladium-bearing copper ores. The production of palladium from primary sources in the United States in 1910 was about 2,100 ounces. What part is derived from ores mined in the United States can not be determined. Among the known sources of the metal are the copper-nickel ores of Sudbury, in Ontario, Canada, the products of which are largely refined in the United States. The Rambler mine in Wyoming, mentioned above, also contains palladium besides copper and platinum. According to the best authority the price of palladium in 1910 was about $1.75 per gram, or $54 per ounce troy. The imports of palladium in 1910, according to the Bureau of Statistics, were 109 ounces troy, valued at $3,570, which would give a value of only about $33 per ounce. The quantity imported in 1910 was considerably less than in 1909, no doubt because the domestic production was able to supply a large part of the demand.

RHODIUM AND RUTHENIUM.

Rhodium is a white metal of the color of aluminum. It is ductile and malleable at red heat. The specific gravity of the melted metal is 12.1 (Deville and Debray), and its melting point is about 2,000° C. The metal occurs in crude platinum in quantities up to 4 per cent and is also contained in the platinum arsenide, sperrylite, found at Sudbury, Canada.

The principal use for this metal is for thermo elements employed in high-temperature determinations. The elements consist of pure platinum and platinum alloyed with 10 per cent of rhodium.

Small quantities of the metal, with some ruthenium, have been made on an experimental scale by the Port Orford Copper Co. from Canadian copper-nickel ores. The price of pure rhodium is stated to be about $5 per gram, or about $155 per ounce troy.

In 1910 the imports of rhodium were 72 ounces, the value assigned being $60.50 per ounce, or $4,356, which is considerably less than the commercial value mentioned above.

Of ruthenium, alloyed with platinum, a small quantity was also imported, probably for chemical uses.

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CADMIUM.

By C. E. Siebenthal.

INTRODUCTION.

A brief account of the production, resources, metallurgy, and uses of cadmium was given as a chapter in Mineral Resources for 1908, and the reader is referred to that paper for further information.

Cadmium has been produced in the United States during the last few years, but its chief output comes from the zinc-producing regions of Silesia, where it is recovered as a by-product in the distillation of zinc. Recently in England a little cadmium has been recovered in the purification of the solution of zinc sulphate in the manufacture of lithopone.

PRODUCTION.

Cadmium has been recovered in the United States since 1907 by the Grasselli Chemical Co., of Cleveland, Ohio. The metallurgical method employed has generally been assumed to be fractional distillation, but this is not confirmed by the company, which prefers not to communicate the process used. Among the possible sources of cadmium in a general chemical works would be the slime left in the production of zinc chloride from zinc scrap, skimmings, etc., or from low-grade roasted zinc ores. As dilute hydrochloric acid dissolves zinc in preference to cadmium, the cadmium content of the zinc scrap, skimmings, etc., is left behind in the slimes. From these slimes the cadmium may be recovered by distillation, by electrolysis, or by purely chemical methods.

The American Smelting and Refining Co. began the production of cadmium in 1910 by the recovery of a few hundred pounds at the Globe smelter in Denver, Colo. It is reported in the mining press that the cadmium is recovered from flue dust. It seems likely that the source of the metal lies in the zinciferous lead ores from Leadville, Colo., and similar ores. Bain [1] noted the presence of cadmium in the zinc ores of the Leadville and Kokomo districts of Colorado, and Guyard [2] gives analyses of flue, chamber, and bag-house dust from Leadville, which show small percentages of cadmium in each. At the time Guyard's analyses were made the ores being smelted at Leadville were mostly carbonates, with little or no sulphides and only a trace of zinc. In the extensive zinc-lead sulphide deposits developed in later years the cadmium content, as shown by Bain, is much higher, so that the bag-house dust from Leadville ores must now show considerably higher proportions of cadmium. In 1908, W. R. Ingalls stated [3] that noteworthy quantities of cadmium occur

[1] Bain, H. F., Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, p. 384.
[2] Guyard, Antony, Geology and mining district of Leadville, Colo.: Mon. U. S. Geol. Survey, vol. 12, 1886, pp. 712, 715, 717.
[3] Mineral Industry, 1907, p. 126.

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in "fume" from lead smelting furnaces collected by bag filtration in Colorado, and that the utilization of this material as a source of cadmium had been considered, though negatived on account of lack of market for the metal.

In smelting such ores the cadmium will distill over from the blast furnaces to the bag house, where it will be caught with arsenic, lead, and antimony. When the burnt fume from the bag house is charged back into the blast furnaces most of the lead and antimony will be recovered in metallic form, but the arsenic and cadmium will again go over to the bag house. In time the fume will be very much enriched in cadmium and arsenic. The difference in temperature at which arsenic and cadmium volatilize allows an easy separation of these metals, and after separation the cadmium residue can be reduced to metallic form without difficulty. The cadmium may be recovered by distillation or by an electrolytic process.

No details of the methods employed in recovering cadmium at the Globe smelter have been made public. It is reported that furnaces are under construction which will have an output of about 1,000 pounds of metallic cadmium per month.

Inasmuch as the production is limited to two firms, the quantity and value of the output can not be given. The local production in 1907 was nearly sufficient to supply the domestic demand—a fact shown by the small imports for that year—but the next year the quantity of cadmium imported was about doubled, and in 1909–10 the imports of cadmium were back at the old figures which obtained before the beginning of cadmium production in the United States. The domestic production has fallen away from the high mark set the first year, but not to the extent that might be inferred from the growth of imports in the last four years, because meanwhile the market for cadmium has somewhat expanded.

PRODUCTION IN GERMANY.

The following table gives the production of cadmium in Upper Silesia from 1882 to 1910, inclusive:

Quantity and value of cadmium produced in Germany, 1882–1910.[a]

Year.	Quantity.	Value.	Average price per pound.	Year.	Quantity.	Value.	Average price per pound.
	Pounds.				*Pounds.*		
1882	7,762	.....	.....	1897	34,231	$42,037.23	$1.23
1883	5,333	.....	.....	1898	32,954	29,666.70	.90
1884	6,118	.....	.....	1899	21,693	15,544.26	.72
1885	7,222	.....	.....	1900	29,835	19,524.81	.65
1886	10,944	$8,710.56	$0.80	1901	28,977	19,754.71	.68
1887	16,140	11,542.29	.72	1902	27,833	15,132.00	.54
1888	10,573	5,439.49	.51	1903	36,519	19,242.06	.53
1889	11,327	4,621.71	.41	1904	55,655	32,882.32	.59
1890	9,167	3,477.18	.38	1905	54,163	35,240.18	.65
1891	6,281	2,423.32	.39	1906	47,368	36,083.89	.76
1892	7,055	2,713.20	.38	1907	72,089	60,757.35	.84
1893	11,651	5,198.87	.45	1908	72,741	48,590.21	.67
1894	15,095	8,393.31	.56	1909	81,962	46,777.16	.57
1895	15,095	9,052.04	.60	1910	90,516	46,449.51	.51
1896	23,514	19,453.64	.83				

[a] Recalculated to pounds and dollars from Statistik des Oberschlesischen Berg- und Hüttenmännischen Vereins, as quoted by Jensch, from Vierteljahreshefte zur Statistik des Deutschen Reichs and from Statistisches Jahrbuch für den Preussischen Staat.

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IMPORTS.

Cadmium is imported into the United States as metallic stick cadmium and as the pigment, cadmium sulphide (CdS), known as "cadmium yellow." The former is free of duty; the latter is dutiable at 30 per cent ad valorem. The value of the imports for consumption of metallic cadmium for 1903 to 1910, inclusive, is given in the table below, which is taken from the records of the Bureau of Statistics. The quantities are not there recorded previous to July, 1909, and for the period preceding that time they have been computed by dividing the values of the imports by the average price of cadmium for the corresponding years in Germany, from which country the cadmium was imported. The quantity of cadmium imported as a pigment and the value thereof are not kept separately by the Bureau of Statistics.

Cadmium imported for consumption into the United States, 1903–1910, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1903	[a] 8,679	$4,565	1908	[a] 3,567	$2,390
1904	[a] 7,655	4,524	1909 first half	[a] 6,659	4,559
1905	[a] 8,138	5,298	1909 second half	2,203	
1906	[a] 13,808	10,522	1910	4,060	2,295
1907	[a] 1,953	1,633			

[a] Prior to July, 1909, the quantities are computed as noted above.

PRICES.

The domestic quotations on cadmium, as reported in the Engineering and Mining Journal during the first half of the year, ranged from 65 to 70 cents per pound in 100-pound lots at Cleveland, Ohio, and during the remainder of the year varied from 60 to 70 cents per pound.

According to Paul Speier, of Breslau, Germany, the price of 99½ per cent cadmium sticks through the greater part of the year ranged between 475 and 525 marks per 100 kilograms (51.3 cents to 56.7 cents per pound). Near the close of the year a strong demand lifted the price to 575 and 600 marks (62.1 cents and 64.8 cents per pound), and several rather large lots were exported to the United States.

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